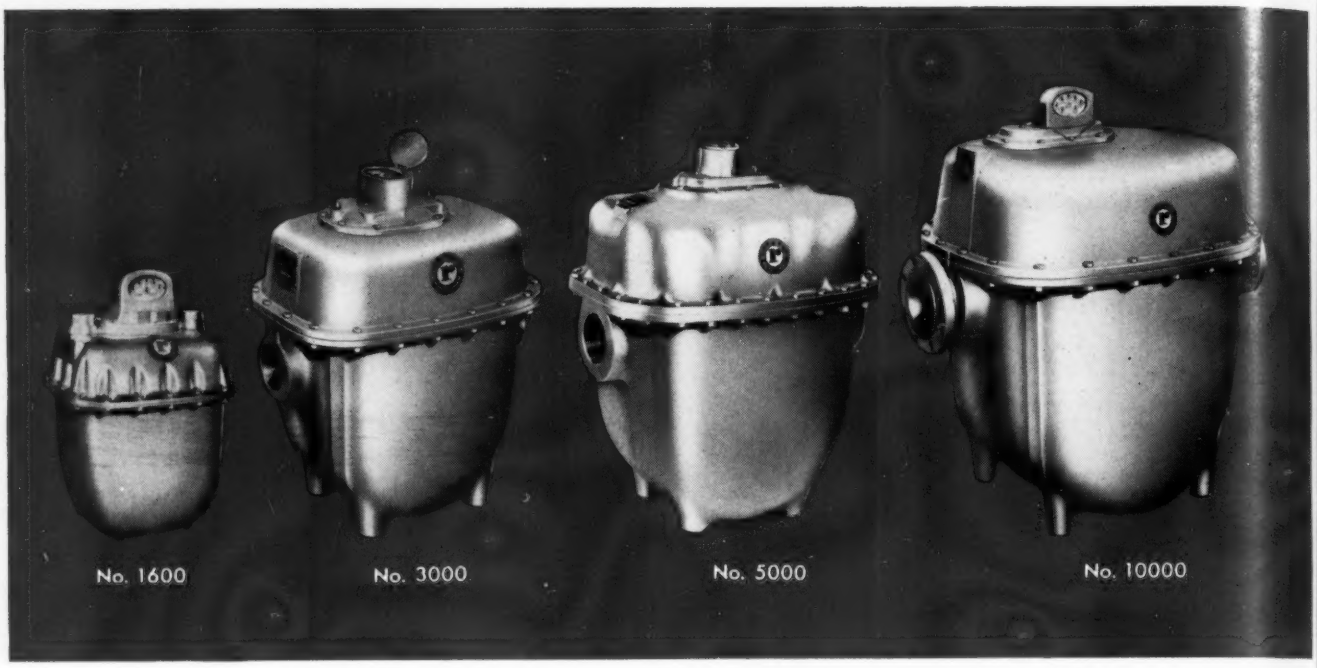
JUNE 1960

American Gas Journal

THE MAGAZINE OF GAS DISTRIBUTION

THE UNIVERSITY OF MICHIGAN
1960



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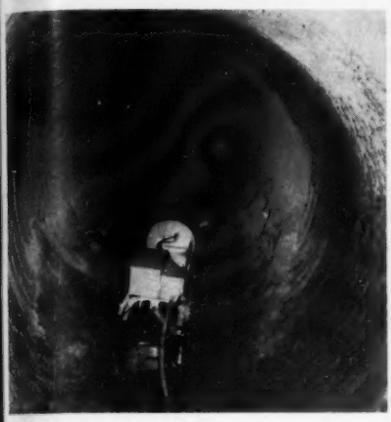

Looking Ahead . . .

And looking around, inside gas mains, is the job of a "new tool" that Consolidated Edison of New York has been employing for several years. Developed to inspect joint sealing operations, the TV camera and equipment has proven useful for other tasks . . . such as locating unmapped connections to mains, checking valve openings, etc. TV cameras now available for inspecting main interiors range down to 3-in. OD in size.

The Good Earth

The old-fashioned idea of pushing dirt into a trench and letting nature take its course is an invitation to trouble. There's more to proper backfilling than that. The job begins . . . not ends . . . when the pipe is laid. Proper backfilling techniques, based on a good working knowledge of soil mechanics, can save you money, time, and effort by providing a proper base for surface restoration and by providing protection of underground structures against mechanical failure. The how and why of backfilling and soil stabilization is told in the article beginning on page 22.

Worth the Money?

How practical is a program of installing stub services ahead of street paving? Are they really used effectively? To find out, New Orleans Public Service put its stub service program under the magnifying glass and came up with some remarkable data. What their study revealed is presented in this issue, beginning on page 29.

Next Month . . .

What's the verdict on compact cars? Report on users' experiences, gasoline mileage figures, and other pro's and con's of small cars will be highlighted next month.

What's new in porous-medium burners? Latest developments in this field will be discussed in a special report on porous-medium burners and their application in modern heat processing.

Take the store to the customer? Why not? Oklahoma Natural Gas is doing just that . . . and getting good results. How they do it is told in next month's AMERICAN GAS JOURNAL.

American Gas Journal

ONLY MAGAZINE EDITED EXCLUSIVELY FOR THE GAS DISTRIBUTION INDUSTRY

Volume 187 **June 1960** **Number 6**

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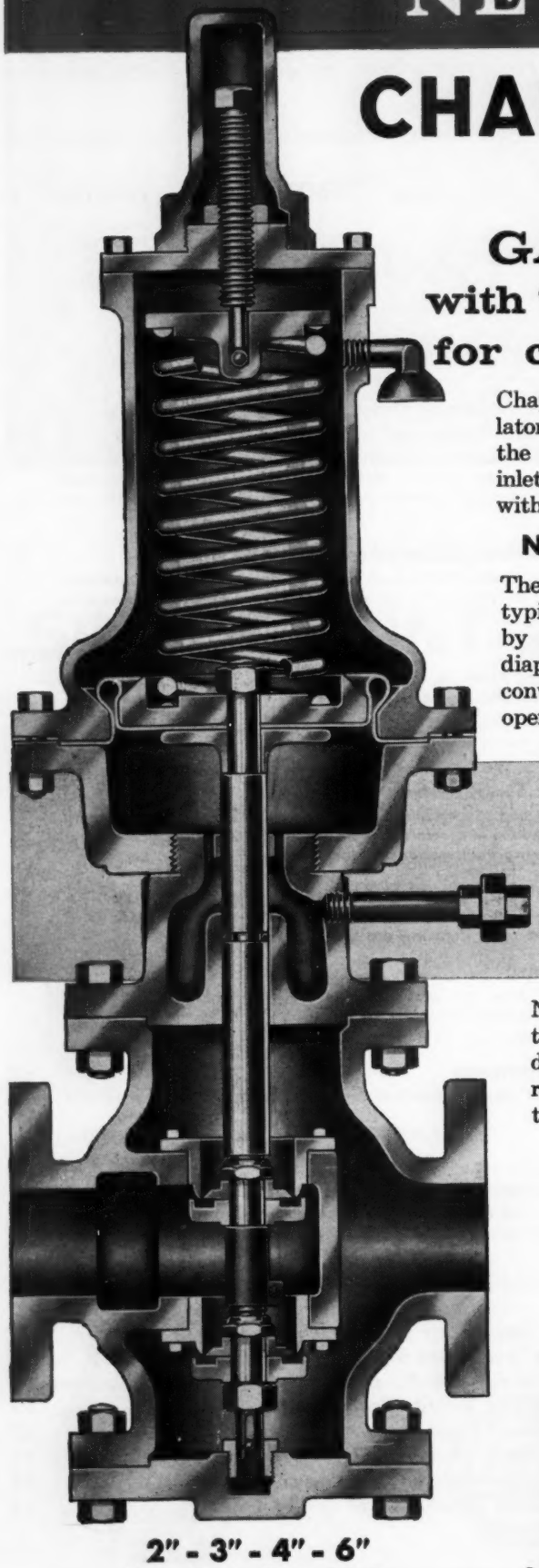

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Write for Bulletin 57-S

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with "ROLL-OUT" Diaphragm for constant pressure control

Chaplin-Fulton Model 57-S is a simple spring loaded regulator which performs like a pilot loaded regulator, without the added complications. For pounds-to-pounds service—inlet pressures to 400 psi—controlled pressures to 75 psi, with deviation through full valve travel less than 1 psi.

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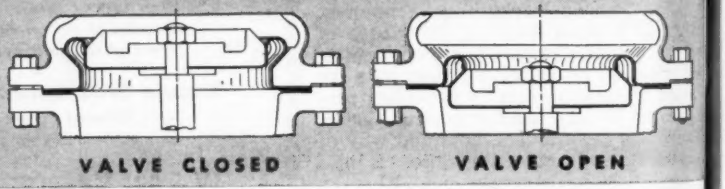

VALVE CLOSED VALVE OPEN

Note how, with the valve upwards in the closed position, the diaphragm achieves its maximum effective area—and decreases as the valve opens. The area changes at the same rate as the spring loses compression, to give a constant controlled pressure—determined entirely by valve movement.

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M C F

NEWS HILITES OF THE INDUSTRY

Chop the gas line off at the curb. That's what the electric utility industry plans to do, using electric home heating as the simplest approach for changing the in-roads of gas appliance sales into the electric appliance market. *In a sense, the "kilowatt kids" declared war on the gas industry at the First National Electric House Heating Exposition and Symposium in Chicago.* The 3-day affair proved an overwhelming success. Only 700 electrical industry personnel were expected—but almost 3000 showed up. C. F. Kreiser, chairman of the Electric House Heating Equipment Section of the National Electrical Manufacturers Association, heralded the advent of an all-out struggle between gas heat and electric heat by declaring that, in the 1970's, *every new home will be built with electric heating.* Kreiser predicted 1,800,000 electrically heated homes by 1965, and over 6,000,000 at the close of the '60's. Kreiser noted that a multi-million dollar sales push is being supplied by the Gold Medallion Home Program of NEMA, General Electric's program, Westinghouse's "Total Electric" program, EEI's "Live Better Electrically" program, and industry-wide business development efforts.

Compact cars are getting a lot of attention from gas distribution utility transportation departments, but there's little agreement on their merits. At a strange "off-the-record" (but public) panel session during the 1960 A.G.A. Distribution Conference in New Orleans in early May, representatives of several major gas utilities discussed their experiences with the compacts. Most reported better mileage figures per gallon of gasoline used; but there was a big variation in the figures. Initial cost was noted as being lower than for standard models in most cases. Despite disagreements, most agreed that they'll be buying and using more compacts in the future. There was harmony on one point—they'll be buying U.S.-made cars, not foreign makes. The reason—ability to get parts and service, plus public reaction.

Phillips Petroleum Company's offer to settle its white-bearded rate case has been met with considerable opposition. Michigan's PSC objects, says rates "must be subject to determination" on a "cost of service" basis . . . Pacific Gas and Electric Company said Phillips was "giving up nothing in its so-called offer". . . the state of Wisconsin said the offer, in effect, would merely postpone for "at least six years" regulation of field prices by the FPC . . . United Gas Improvement Company said the offer, if accepted, would only "perpetuate" the "state of indecision and confusion" now existing.

Drop-in gas "power-burner" surface unit will be marketed in 1960—maybe this summer—by Whirlpool. The power-burner unit was shown in the Whirlpool "Miracle Gas Kitchen" that featured many futuristic gas appliances.

New FPC appointees nominated by President Eisenhower are both government career lawyers without regulatory agency experience. Thomas J. Donegan has been named to succeed William R. Connole, and Paul A. Sweeney has been picked to succeed the late John B. Hussey. Choosing to make an election-year political issue of the FPC appointments, Senator Proxmire (a very-liberal Democrat from Wisconsin) has made a big fuss over the appointments, particularly the replacement of Connole. Sen. Proxmire has stated that, unless the FPC appointees have adequate background in public utility regulation, they would find it "extremely difficult" to "resist the industry point of view." Proxmire said the FPC needed at least one man who would be willing to "stand up" and disagree with the "huge gas corporations that dominate the FPC." No one familiar with FPC operations believes that the Commission is dominated by gas companies; rather, the FPC's troubles stem from domination by the ultra-liberal directives of the higher courts that have almost completely rewritten the original objectives of the Natural Gas Act . . . without benefit of legislation.

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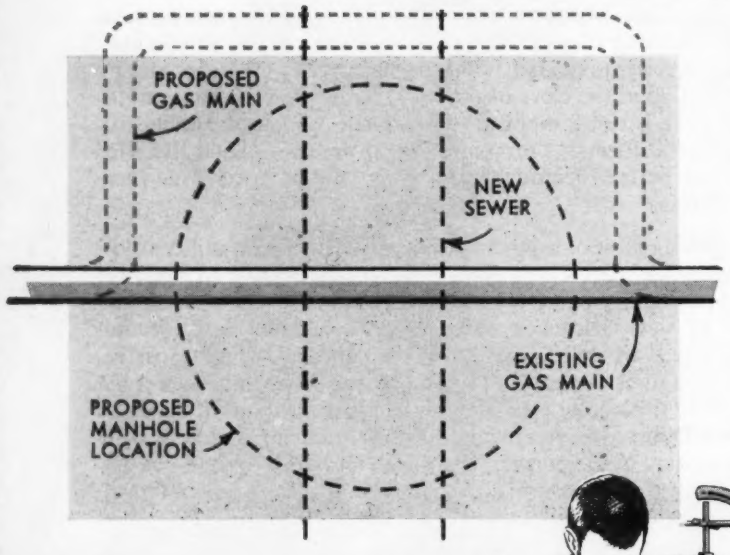
RELOCATE GAS LINES QUICKLY and SAFELY with

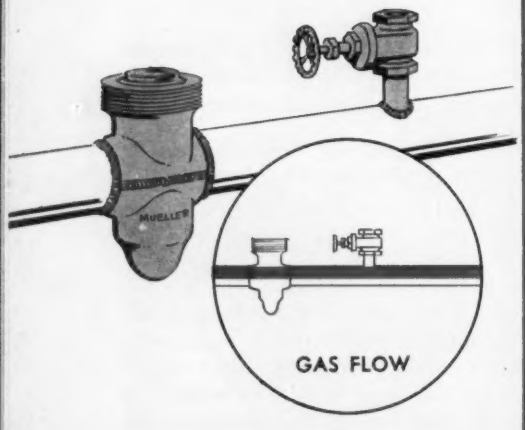
MUELLER® NO-BLO® METHOD Machines and Equipment

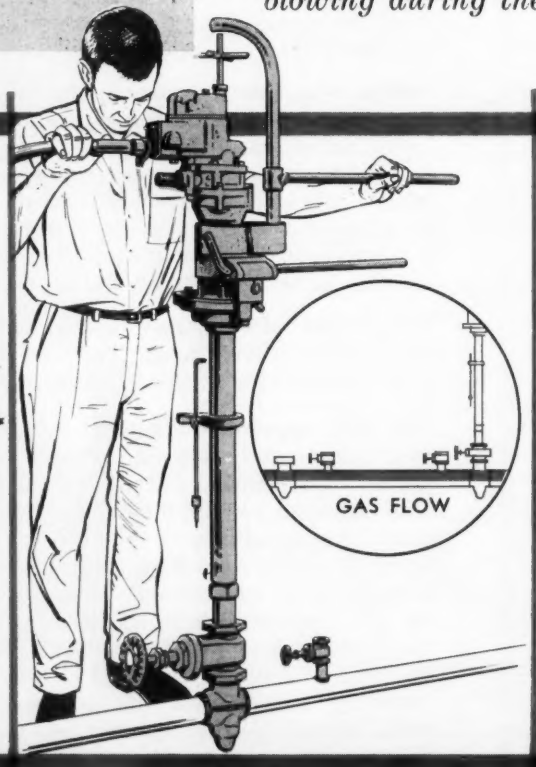


■ Recently a new sewer trunk line and manhole installation posed a tough line relocation problem for a gas utility company. Serving an industrial and residential area, service could not be interrupted during relocation of the line.

This schematic diagram of the problem and the step by step illustrations show how the line was relocated with Mueller No-Blo Method Line Stopper Fittings and Equipment . . . *without interrupting service* and *without gas blowing during the entire operation.*

here's how:





STEP 1 ATTACH FITTINGS

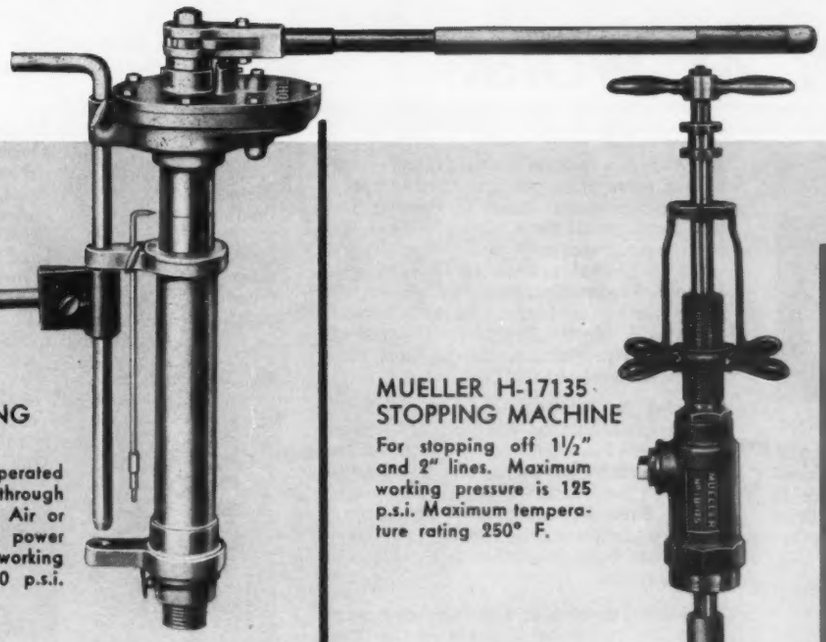
Weld Mueller Line Stopper Fittings to main on each side of section to be relocated. Weld Save-A-Valve Drilling Nipples to line providing by-pass and purging connections. Attach gate valves to drilling nipples.

STEP 2 DRILL MAIN

Attach special Mueller gate valve to stopper fitting. Attach DH-2 Drilling Machine (or D-4 Drilling Machine) to gate valve. Make cut, retract drill, close gate valve and remove drilling machine. Repeat cutting operation in second line stopper fitting and Save-A-Valve Drilling Nipples.

STEP 3 CONNECT BY-PASS

Attach line stopper to H-17135 Stopping Machine and attach Machine to gate valve. Connect by-pass line between the H-17135 Stopping Machines. Purge by-pass, then start flow through the by-pass line.



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MUELLER H-17135 STOPPING MACHINE

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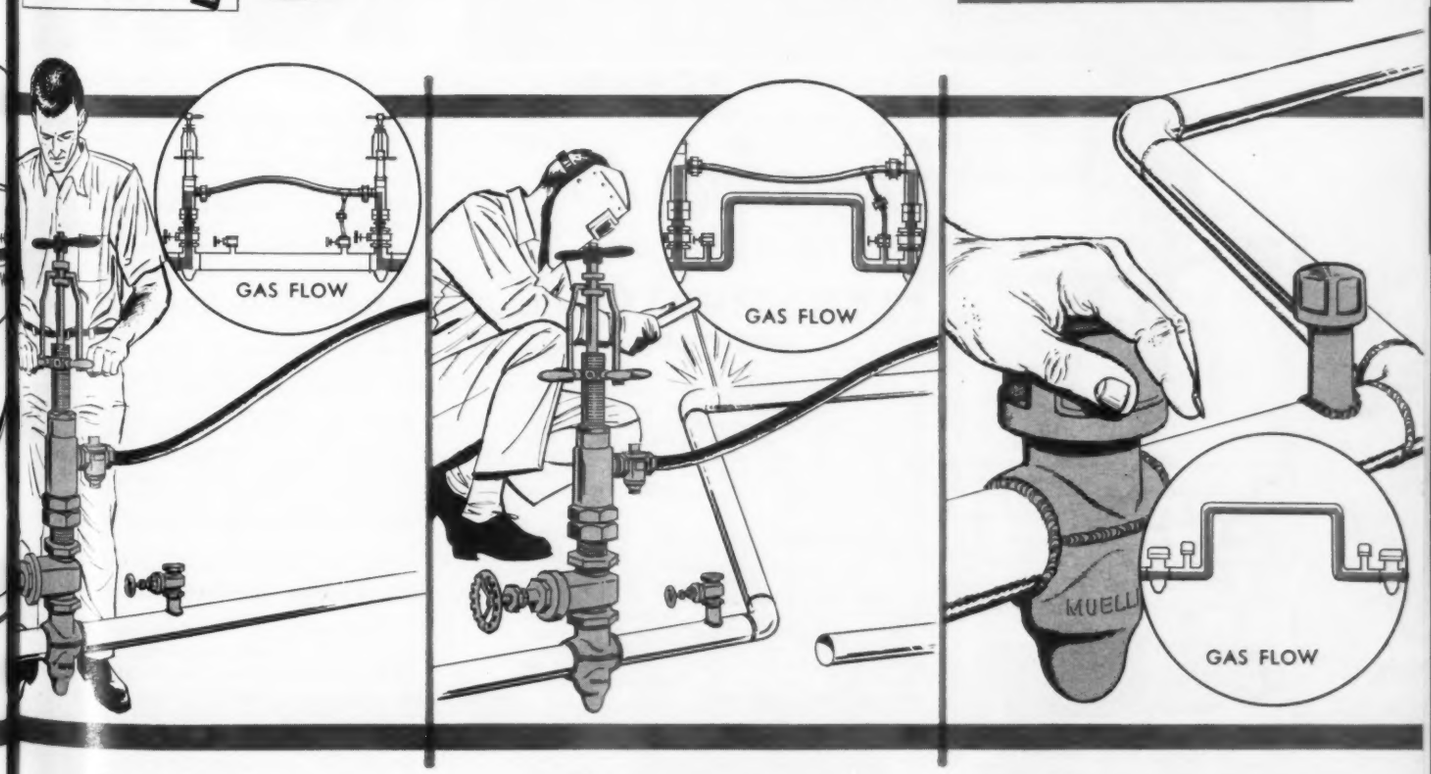

STEP 4 STOP-OFF

Open gate valve on upstream stopper fitting, insert and expand stopper. Repeat stop-off operation on downstream stopper fitting. Section is now isolated.

STEP 5 RELOCATE MAIN

With by-pass line maintaining flow of gas without interruption or shut-down, the isolated section can be removed and relocated. Test new welds before activating new section.

STEP 6 ACTIVATE MAIN

Purge isolated main section after welds have cooled. Using Unit #1 Stopping Machine, remove line stopper in downstream fitting and close gate valve. Then remove line stopper fitting in upstream fitting. Main section is now in operation. Remove by-pass. Plug and cap line stopper fittings and drilling nipples.

MEN AT WORK

IN THE GAS DISTRIBUTION INDUSTRY

F. J. McLaughlin

C. W. Provonchee

● **Charles W. Provonchee** of Rehoboth, has been elected executive vice president of Providence Gas Co., and **Francis J. McLaughlin, Jr.** of Warwick, has been elected vice president in charge of sales.

● Elizabethtown Consolidated Gas Co. has appointed **Peter Kassak** as chief engineer. He was formerly associated with Public Service Electric and Gas Co. as district superintendent in Summit.

● **The Greenwich Gas Co.** has elected **Richard A. Winslow** vice president-sales, and **Walter E. Swanson,** treasurer. Other officers re-elected by the board of directors were **Frederic L. Putnam,** chairman of the board; **David T. Gilbert,** president, **Wilbur B. Abrams,** vice president, operations, and **Gardner L. Bristol,** secretary.

● **George S. Young** has been elected chairman of the board and chief executive officer of the Columbia Gas System, Inc. **Cecil E. Loomis** has been elected president succeeding Young.

● Michigan Consolidated Gas Co. has named three of its northern district executives to new posts: **James C. Preston,** former manager of the Cadillac district, has been named general manager of operations in central and northern Michigan. **Reno J. Maccardini,** former engineer, has been named assistant general manager. **Thomas K. Horton,** sales and office supervisor in Mt. Pleasant district, has been named manager of the Cadillac district.

● **John J. Tuohy,** president of Long Island Lighting Co., has been designated chief executive officer. **Errol W. Doebler,** who was chief executive officer until this change, continues as chairman of the board. **Fred C. Eggerstedt, Jr.,** assistant vice president in charge of finance department, has been elected vice president of the company.

● South Jersey Gas Co. has announced three key personnel changes in the company's divisional set-up: **Edward R. Budd,** manager for Atlantic City division, moves to head the Glassboro division of the company. **Jarvis D. Lynch,** division manager for Glassboro, has been transferred to take over the Cumberland division. **George E. Emmons,** commercial manager for Cumberland division, assumes the duties of Atlantic City division manager.

● **Remick McDowell,** president of The Peoples Gas Light and Coke Co. has been elected a director of the company to fill the vacancy created by the death of Edward E. Brown.

● **James C. Reid** has been elected president of Southern Union Gas Co. succeeding **C. H. Zachry,** who is retiring after serving as officer of Southern Union for 27 years. Other newly-elected officers of the utility are: **Scott Hughes,** executive vice president, **A. M. Wiederkehr,** vice president, gas supply and exploration, **N. P. Chesnutt,** vice president and operating manager, and **H. V. McConkey,** secretary-treasurer. **J. R. Cole** of Santa Fe, has been named senior vice president; **Tom Corr** of Albuquerque, vice president, northwest division; and **E. M. Kelley** of El Paso, vice president southwest division.

● **Dale Te Kolste** has been promoted to vice president and general manager of the Peoples Natural Gas Division of Northern Natural Gas Co. succeeding **Donald L. Sedgwick** who retired May 1 as head of the company's distribution division.

Dale Te Kolste

James C. Reid

Howard Boyd

H. E. Schwalm

● El Paso Natural Gas Co. has elected **Paul Kayser** to the newly-created post of chairman of the board and chief executive officer. **Howard Boyd,** formerly executive vice president, has been elected president succeeding Kayser. **Arnold R. LaForce,** formerly financial vice president, has been elected executive vice president.

● **Harold E. Schwalm,** formerly superintendent of supply for Northern Illinois Gas Co., has been appointed to the newly-created post of superintendent of storage. He is responsible for preliminary investigation, development and testing of NI-Gas' underground aquifer storage projects. **D. V. "Dave" Meiller,** formerly an engineer assistant to the manager of operation, has been named to succeed Schwalm as superintendent of supply.

Deaths

J. D. Davis, 59, vice president of United Gas Corp. A veteran of the natural gas industry, he had been employed by United Gas for more than 35 years.

Harry Cain, 60, assistant to the public relations director of United Gas Corp. for the past 10 years. He was a veteran of 24 years service with United Gas.

Willis L. Lea, Jr., vice president and general attorney for Southern Union Gas Co.

Robert Glenn Cushing, Atlanta division engineer, Atlanta Gas Light Co.

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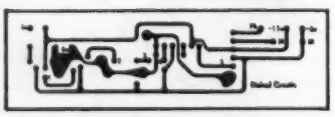
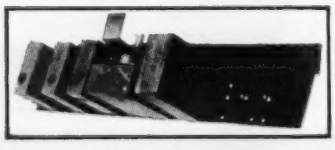
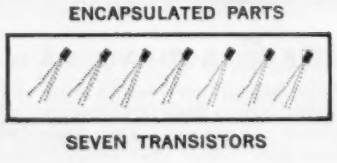


ETCHED CIRCUITRY



ENCAPSULATED PARTS



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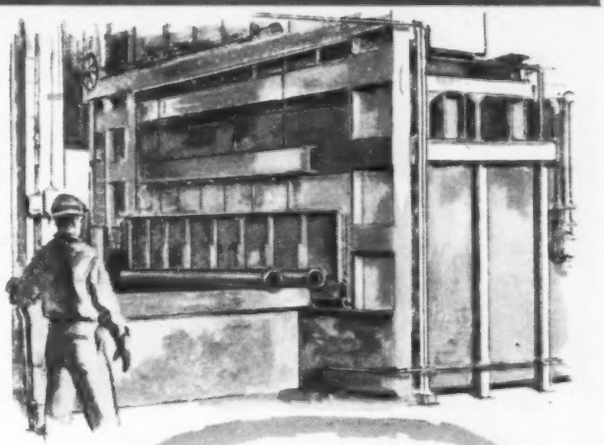

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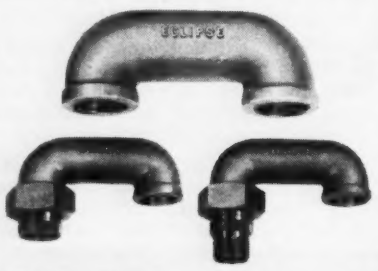
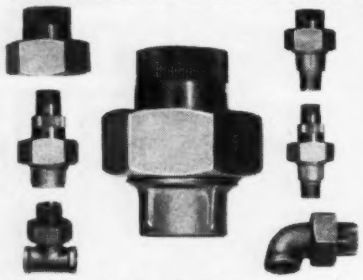
GAS SERVICE PRODUCTS

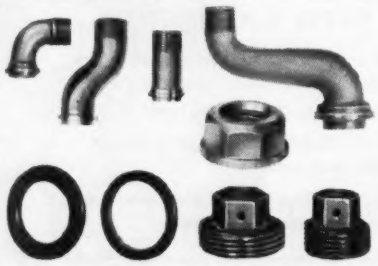
For Safer, More Attractive and Economical Meter Installations



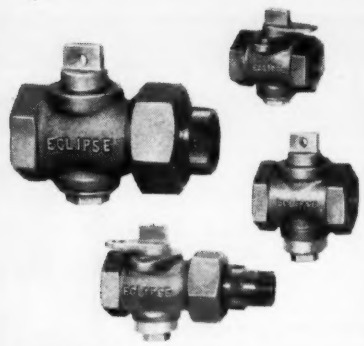
Return Bends
Cut down number of threaded joints, save pipe fitting time, and assure parallel piping in your meter sets. Plain and Wedgeseal-Insulated, female by male and female by female. Bulletin No. 500-2.



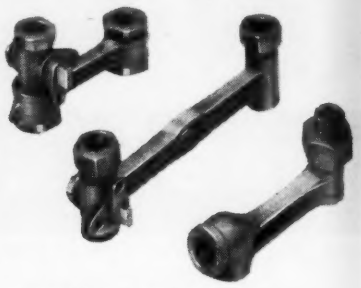
Unions, Tees & Elbows
A wide variety of Wedgeseal-Insulated types with versatile combinations of male or female threaded ends. Accurate, time-saving, and effective insulation. Bulletin No. 400-2.



Swivels, Nuts, Accessories
"Certified" construction, accurately machined. Complete stock of straight, offset and adapter swivels and nuts. Bulletin No. 300 for swivels and nuts; No. 1900 for accessory items.



Gas Cocks
Iron body, red brass core with either standard or "Retained Key" construction. Also furnished with integral Wedgeseal-Insulated union either male or female. Bulletin No. 600-2.



Rigid Meter Bars
Union, sleeve or compression type. Union type available in Wedgeseal-Insulated, standard gasket, or brass-to-iron ground joint — with standard key or "Retained Key" integral gas cock available. Bulletin No. 200-2.

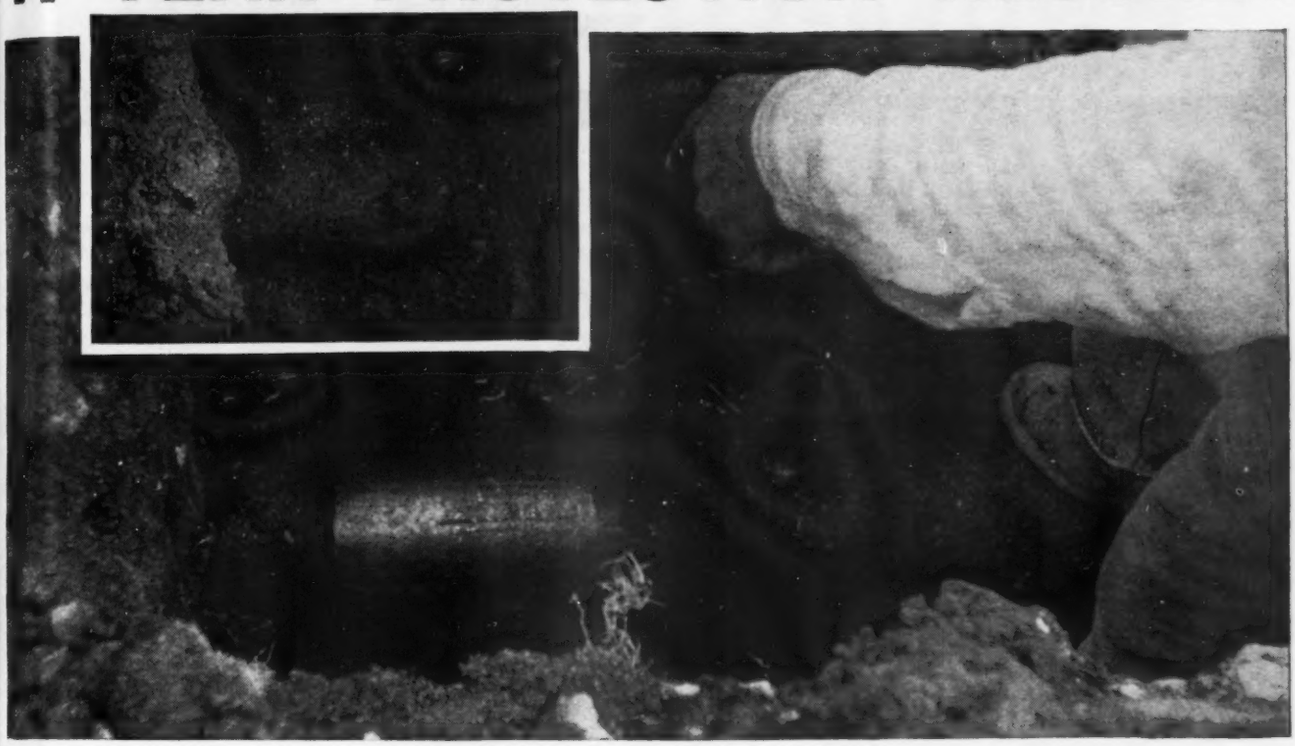
You benefit from one source of supply, one responsibility with Eclipse Gas Service Products. Dense, solid castings — free from porosity — are used throughout with accurately machined collars, pilots, and threads.

Eclipse Wedgeseal-Insulated union, meter bar, gas cock, and return bend packages offer 100% protection against stray or induced house currents . . . prevent electrolytic corrosion . . . the multipurpose units cut down on the number of threaded joints in your gas service piping and meter installations. The integral insulator cannot be left out — nor will it shear off, pull out, or crack during service. Ask for descriptive bulletins and specification sheets.

Eclipse®

GAS SERVICE PRODUCTS DIVISION
ECLIPSE FUEL ENGINEERING COMPANY
1108 Buchanan St., Rockford, Illinois

17-YEAR PROTECTION RECORD!



Year After Year...More Evidence Proving That TAPECOAT® Adds Years of Service Life to Gas Lines Underground or Under Water

Right across the country, TAPECOAT installations prove that you get more for your money when you measure pipe protection with a calendar.

Since this cost-cutting coal tar coating in tape form was first introduced in 1941, it has demonstrated its ability to withstand severe conditions underground or under water. TAPECOATED lines dug up after 17 years of service show no signs of deterioration on the pipe.

Typical is the experience of a utility in a coastal area. For a thorough trial, this company applied TAPECOAT in areas where severe corrosive conditions were known to exist. The lines were dug up this year and, after years of service under severe conditions such as brackish waters and corrosive soil, the pipe showed no signs of corrosion, proving the quality of TAPECOAT protection.

In terms of preventive maintenance and replacement costs, performances like this emphasize the most important consideration in buying protection. Remember, TAPECOAT is a hot-applied coal tar coating in tape form—designed for lasting protection on pipe, pipe joints, service connections, mechanical couplings, fittings, insulated lines, tanks, tie rods, and other steel surfaces vulnerable to corrosion.

TAPECOAT comes in rolls of various widths and is available in asphalt. Where primer is desired, specify TC Primecoat, the compatible coal tar primer.

A TAPECOAT sales and service engineer is always available to help you on any corrosion problem. Write for complete details today!

The TAPECOAT *Company*

ORIGINATORS OF COAL TAR COATING IN TAPE FORM

1533 Lyons Street, Evanston, Illinois

REPRESENTATIVES IN PRINCIPAL CITIES

Manufactured and Distributed in Canada by The Tapecoat Company of Canada, Ltd., 25 Haas Road, Rexdale, Ontario.

IN 1959, We learned some amazing facts about...

THE BOOMING PACIFIC NORTHWEST

Did you know that the normal summer temperatures in Seattle and Portland, largest cities in the Pacific Northwest, have the delightful range of 56° to 79°? Or that their winter temperatures are in the moderate 35° to 45° range? Or that annual precipitation in these booming economic centers is under 40 inches (less than New York City or Little Rock) with little snow?

The facts about the climate of Seattle, Portland, Spokane, Tacoma, Olympia and other Pacific Northwest cities were not a surprise to us. But we didn't know that Portland's winter weather was more moderate than in Louisville, Kentucky. We didn't know that Seattle's summers were cooler than in Portland, Maine.

In fact, when El Paso Natural Gas Company began to serve this dynamic region, we learned a lot of new things about a northwest wonderland destined for an increasingly major role in America's economic future.

Washington and Oregon, and their neighboring states, are on the go. Long famed for natural resources, for scenery, for vitality, the Pacific Northwest's growing population and expanding economy are a guarantee of future prosperity.

If you're looking for a major industrial site — or a better place to build a home — visit the Pacific Northwest. You'll be sold, just as we were. And you'll want to stay.

* * *

Not the least of the Pacific Northwest's economic assets is natural gas, furnished by El Paso Natural Gas Company. In 1959, El Paso took major steps to assure energy supplies for the Pacific Northwest, and to continue to meet the mounting energy demands of California and the Southwest, whose growth has paced the nation since World War II.

The dynamic Pacific Northwest is featured in photographs in El Paso's 1959 Annual Report. El Paso's broadened service area and plans for the future, outlined in this Annual Report, assure 11 Western states the dependable long-term gas supplies so necessary to sound and speedy economic growth.

NORMAL TEMPERATURE AND PRECIPITATION, SELECTED CITIES IN PACIFIC NORTHWEST*

	SUMMER TEMPERATURE	WINTER TEMPERATURE	ANNUAL PRECIPITATION
SEATTLE:	56°-75°	36°-45°	31.92 inches
PORTLAND:	58°-79°	35°-44°	39.91 inches
SPOKANE:	57°-82°	20°-30°	14.92 inches
TACOMA:	55°-74°	34°-44°	35.20 inches
OLYMPIA:	49°-76°	31°-43°	45.74 inches

*Weather Bureau, U.S. Department of Commerce.

EL PASO NATURAL GAS COMPANY

For Copies of El Paso's 1959 Annual Report, Or Further Information On the Pacific Northwest, Write to El Paso Natural Gas Company, El Paso, Texas

El Paso Natural Gas Company provides natural gas to industrial customers and distribution companies in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, West Texas and Wyoming.

NEW HANDLEY-BROWN

lifetime pipeline markers and sign posts . . .

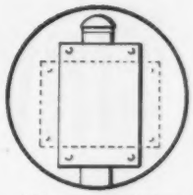
Never need painting. Won't rust or shatter!

This new, non-metallic* pipeline sign post saves money three ways. Chemically bonded color eliminates painting maintenance. The posts are light and easy to handle and store, come conveniently packaged 5 to a container. And they're sturdy, even gun shots won't shatter them.

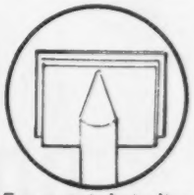
Equally important, both pipeline markers and sign posts can be designed to meet your specific requirements. Marker posts and side-mounted sign posts may be equipped with cathodic terminal caps or vent caps. Climbers may also be added.

A 5″ square foot piece is solvent-welded to the bottom of the post to prevent rotation. It anchors the post securely in the ground.

IT WILL PAY YOU TO GET THE FACTS FROM HANDLEY-BROWN. WRITE TODAY.



Side-mounted sign, (vertical or horizontal). Front view shown above.



Top-mounted pipeline sign post (vertical or horizontal). *Rear view shown above.*

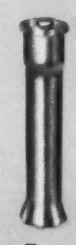
Marker Post with cap

Marker Post with vent cap

Cathodic terminal cap for pipeline marker post

End call backs with attractive H-B outside meter boxes. Available as shown, or for recessed installation. Made of tough resin-rubber compound*.

Master Poly-Trol *automatic* gas shut-off valve. Shuts-off gas in event of over-pressure, underpressure, excessive high temperature, and flooding. Serves also as a tamper-proof manual shut-off.



H-B Cathodic Terminal Box Landscape engineered, and non-corroding*. Leads are attached to the terminal block in the cap for easy testing.

Curb boxes—extension-type. Easy to find. Light. Tough. Safe. Made of resin-rubber compound*. Non-corroding, collapsible type. Equipped with permanent magnets—fast action on finders. Roadway valve boxes also available.

Service Test Station. Provides a test station for leak surveys. Permanently installed. Makes random probing unnecessary. Made of tough resin-rubber compound*.

specifications:

Post Length: 7′ (other sizes available on request)

Post Diameter: 3½″

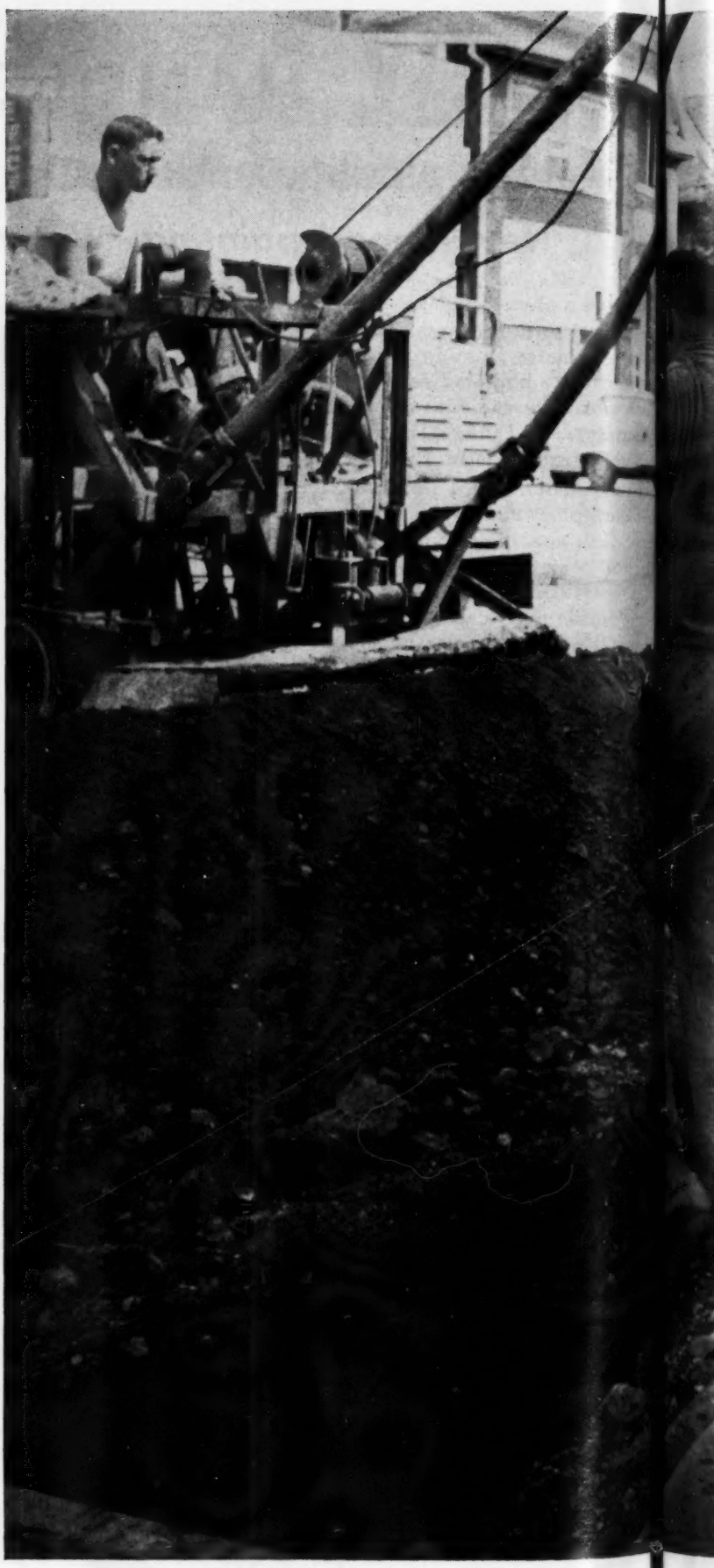
Wall Thickness: 3/16″.

**A. B. S. Polymer*

HANDLEY-BROWN CO.

2104 BROOKLYN ROAD • JACKSON, MICHIGAN

INVESTING MONEY... OR JUST SPENDING IT?



Let's say you are considering pipe for gas utility expansion.

Your most important consideration is to make the best investment possible.

Utilities that select cast iron pipe are *investing* their money wisely, because an installation of cast iron pipe rarely requires major repairs for at least a century.

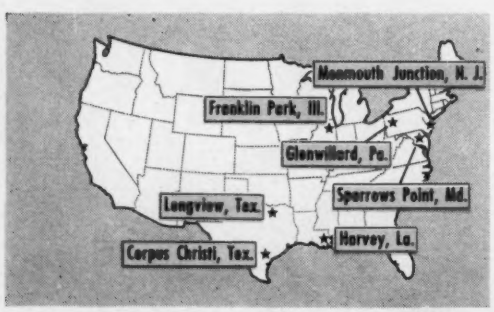
That's a big statement, but 62 American cities now using cast iron pipe gas mains over a century old testify to it.

Rugged and durable, cast iron pipe withstands all the usual stresses to which underground pipe is normally subjected. And mechanical joints remain tight under normal distribution pressures.

CAST IRON PIPE RESEARCH ASSOCIATION,
Thos. F. Wolfe, Managing Director,
3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

Coating and wrapping facilities located near major pipe-producing areas provide buying flexibility, uniform protection



Because PLS plants with their vast storage areas are so strategically located, your pipe buying procedure can be greatly simplified . . . a load of detail lifted off your shoulders. You order from the desired pipe mill, specify delivery to the PLS plant serving the area, and we take it from there! There's always room at our 150 acres of plant sites to store your pipe until the exact time of need. Pipe can be released for processing and be on its way to the project in a matter of a few days. Savings in time often add up to weeks when plant-applied coatings are specified. Delivery of PLS coated and wrapped pipe is assured WHEN you want it, where you need it. So, let PLS carry that load for you. Call our nearest representative and get all the details.

Sales offices at all plant locations... and Atlanta, Georgia; Houston, Texas; Lincoln, Nebraska; Syracuse, New York; and Dallas, Texas

GEM

PIPE LINE SERVICE CORP. SERVICE EQUIPMENT MATERIALS FRANKLIN PARK, ILL.

Pipe Line Service Corporation

FRANKLIN PARK, ILLINOIS

Quality pioneers in coating and wrapping pipe for over a quarter century

A SUBSIDIARY OF AMERICAN STEEL FOUNDRIES

When you install services -use a REAL saddle!

Massive malleable iron construction. Hinged on one side. Single oversized plated bolt. Simplicity itself. Full contour contact—can't crush.

New "pillow" type neoprene gasket bonded inside cast retainer rings, preventing cold flow or blowing out under high pressure.

Each saddle pressure-formed to a perfect circle fit, soap-and-water tested. Write for special Folder SSS.

M. B. SKINNER CO.
South Bend 21, Ind.

SKINNER-SEAL SERVICE SADDLE

New plan proposes that gas pipeline companies have control over peak shaving plants of gas distribution companies and, in turn, pay for having "peak shaving" gas made to the pipeline's order; utilities would benefit from lower demand charges, pipelines would gain increased capacity

ROUND TABLE

Monthly Forum on Fuel for Thought

Are Transmission Companies Overlooking An Opportunity to Increase Effective Line Capacity?

L. C. Rohret, *Middle West Service Company, Chicago, Illinois*

FOR A GAS TRANSMISSION COMPANY HAVING NO STORAGE FACILITIES, the amount of gas transmitted through a pipeline is a function of the load factor and the full line capacity. Most transmission companies are constantly seeking new loads that will better their load factor and are encouraging the gas distribution companies to do the same.

The distribution companies, many of which have relatively low load factors and at the same time are paying a high demand charge, are faced with the problem of bettering their load factor in order to purchase their gas requirements at the lowest price possible under the existing tariffs.

One way to better the load factor and reduce the average cost per Mcf is to develop more off-peak load, but the opportunities to sell such loads are limited by the market capable of utilizing seasonal, off-peak or interruptible gas at a reasonable price. In order to develop more sales, the companies may lower the rate of gas in these classifications; this may increase the amount of gas sold and may increase the gross revenue, but the spread between the average purchase price and the average selling price of gas may be reduced to such a degree as to result in a lower net revenue.

An alternative to such a practice is peak shaving by the distribution company. This is not altogether satisfactory for a number of reasons, a few of which we will review here.

Peak shaving requires a certain amount of generating equipment, a stock of material from which to make the gas, and a trained crew ready to drop whatever it may be working on in order that the gas necessary to meet the peak demand may be made.

The ideal situation would be to have equipment of sufficient capacity to carry the entire load after the contract demand has been exhausted, but this is impractical in most cases. The cost of such an installation is high; the carrying charges on so large an investment added to the maintenance, operating, and other expenses may be a greater burden to carry than can be justified. Practical considerations will reduce this investment and the peak shaving capacity to some figure the company feels is reasonable.

To obtain the maximum benefit from peak shaving, accurate weather and load forecasting is necessary and careful load dispatching is required, and the requirements must be estimated at the start of the day. Sudden weather changes may reduce or eliminate the need for peak shaving with the result that a considerable amount of high cost peak shaving gas may have been made and distributed. Several such starts in peak shaving may be made before a peak load develops that actually requires shaving. These starts add to the cost of operation and several such starts in quick succession may seriously deplete the material stocks before such stocks can be replenished.

The irony of the situation is that the peak demand for the distribution company may not fall on the same day the peak demand is made on the pipeline, and the pipeline company may have a surplus of gas at the time that might just as well be used.

One purpose of the contract demand is to give the pipeline company a measure of control over the total demands of the distribution companies and hold these demands within the ability of the pipeline to deliver. The pipeline company is the only agency that knows when the capacity of the line is being approached, and only the pipeline company knows when peak shaving is actually required to protect its service.

Having this knowledge, is it not logical that the pipeline should decide when peak shaving should be done?

Unlike the distribution company, it is not necessary that the pipeline forecast in advance when peak shaving will be necessary, as the only criteria they require is the observation of falling pipeline pressures.

While the pipeline companies ordinarily do not install or operate peak shaving equipment, would it not be possible for the pipeline company to work out an arrangement with the distribution companies whereby the distribution companies would operate the peak shaving equipment under instructions from the pipeline load dispatcher?

In return, might not the distribution company be allowed a credit upon its demand charges in an amount equal to the company's ability to peak shave?

The major operating problems would need to be considered and settled during the preliminary negotiations. The detailed operating procedures and routines would need to be developed along with the working arrangements between the pipeline and the distribution companies and would become a part of the agreement. Most of the details of such an agreement would, most likely, be indicated by the load requirements and other conditions and circumstances. These details might be modified from time to time to meet changing conditions.

It might be necessary to limit the quantity of gas the distribution company would be required to supply during any one season but an estimate, acceptable to both the pipeline company and the distribution company, of the total amount of gas which would be required for an average or normal year might be made and agreed upon. Any gas in excess of this estimate could be supplied to the pipeline company at an agreed price.

A home run every time !!!

Hard-hitting GEM advertisements reach the homeowner at home... where he's most receptive to home improvement suggestions. That's why the GEM Program is so successful in selling the comfort and convenience of gas and gas equipment for the big household jobs.

GEM ads in national consumer magazines like Better Homes and Gardens, New Homes Guide and Home Modernizing keep homeowners aware of the many advantages offered by modern gas service. That's how the GEM Program helps them ensure the future prosperity of everyone in the Gas Industry!

Suppliers to the Gas Industry are invited to participate in the GEM Program. For details, ask any sponsor or write to Gas Equipment Manufacturers Group, Room 2925, 60 East 42 Street, New York, N. Y.

This advertisement, in recognition of the GEM Program and its continuing support of the Gas Industry, is contributed by the...

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METER COMPANY
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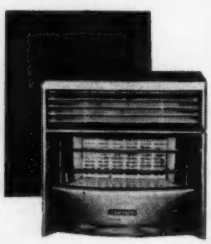
EVERYONE'S A CUSTOMER FOR A **DEARBORN**

"Anybody Home?"

As a matter of fact, *everyone's* at home (and ready to buy) when you're selling Dearborn, the world's finest *area* heating products. So don't be spooked by others' claims. Dearborn has the beauty, the engineering and the lasting quality that means solid profit year after year. *Now* is the time to see your Dearborn salesman . . . for a great '60 heater season!

COOL SAFETY CABINET

The most amazing feature of America's foremost heating line. The top, sides and back of every Dearborn is *cool* to the touch. Put the heat in the living area . . . where it's wanted!



The Dearborn Crest is the world's finest unvented gas area heater, a standard of quality for the heating industry.

Dearborn®

Get details of Dearborn's clean-cut selling policy from any of these regional sales offices: Atlanta, Chicago, Dallas, Los Angeles, San Francisco.

1960 Dearborn Stove Co., Dallas

The operating position of the distribution company would be improved to the extent that it could develop its gas sales to the maximum without the threat of penalties for exceeding the contract demand. It would know in advance the maximum amount of gas it might be called upon to produce during any one season at its own expense for its own use and could estimate with reasonable accuracy what the total cost of this gas would be. And, if the pipeline company did not require any peak shaving, the distribution company would not be put to the production expense it might otherwise have to assume to avoid exceeding its contract demand.

In the above we have considered only the advantages to the distribution companies, but the assurance of the distribution companies that they could sell more gas would reflect back upon the pipeline company in the form of increased commodity gas sales with the attendant betterment of the load factor.

A plan of this type, or some modification of it, would provide a uniform and integrated plan to replace the present hit or miss system of peak shaving as it is now practiced.

It would provide for better cooperation between the pipeline company and the distribution company, and would permit the most efficient utilization of the peak shaving equipment. In such a plan, certain operating details would need to be worked out — such as periodic inspections by a representative of the pipeline company and an occasional short test run to obtain the assurance that the equipment was prepared to operate properly when called upon.

The plan should provide for the notification to the distribution company by the pipeline company of large pressure drops with advice that, if the pressure should continue to drop, it might be necessary to call upon the distribution company to operate its peak shaving equipment. The purpose of this notification would be to alert the distribution company and to give it ample time to assemble its operating crews and make ready to go into action the moment official notification to start up is received.

A schedule of payment for any gas requested by the pipeline company, in excess of the estimated annual peak shaving requirement, would need be prepared and agreed upon. It is possible that distribution companies that have been loath to install or operate peak shaving equipment might be induced to do so once they see the benefits to be derived under this plan.

Not all of the distribution companies do peak shaving, even though some may be prepared to do so, as many of them have felt they could not justify the cost of the operation. Perhaps, for some, the contract demand rate was low and the savings to be effected were not sufficient to warrant peak shaving; perhaps some did not have sufficient skilled forecasting facilities that would enable them to peak shave efficiently. Some others may have preferred to consider such equipment as they had in the light of standby equipment, and others may have felt that the savings would not warrant the gamble of trying to outguess the weather.

If a supplying pipeline company should present to the distribution companies a unified plan with the risks and gambles of peak shaving modified, perhaps the companies that have shunned peak shaving in the past will reconsider the idea as they are all becoming increasingly aware of mounting demand charges.

All distribution companies would need to be given an equal opportunity to participate in the plan to whatever extent they may elect and such participation would be limited by the capacity of their peak shaving equipment.

The pipeline company would benefit by obtaining, with no additional investment on its part, the equivalent of an increased pipeline capacity equal to the total capacity of all the peak shaving equipment attached to its system.

The pipeline would have no operating expense, maintenance, taxes or other fixed charges upon this equivalent capacity. The pipelines' normal expense would be only the occasional inspection of the equipment to assure themselves that the equipment was in proper condition to operate on a moment's notice, to check the quantity of the fuel stocks on hand, and the expense of notifying its customers when to start up and stop their plants.

The only additional expense might be occasioned by the pipelines' request to the distribution companies for peak shaving gas to meet some emergency after the distribution company had fulfilled its agreement. This has been pointed out in an earlier paragraph.

The distribution company would benefit by developing maximum loads with the smallest possible demand charge. It would be able to predict with reasonable accuracy its gas costs for the ensuing year and would be relieved of the necessity of predicting the weather on days of heavy demand.

The replacement of the present disorganized and inefficient system of peak shaving by individual companies, with an integrated system directed by the pipeline company that is in a position to see the entire picture, would benefit everyone to whatever extent they elected to participate. * * *

relax

let Southern Cross account for your "unaccounted-for"

Don't let execessive unaccounted-for worry you—with SCF on the job you can r-e-l-a-x confident your leak location program will be handled efficiently and to your complete satisfaction.

Distribution executives nationwide verify that Southern Cross Foresters account for unaccounted-for, help improve profits, and raise the safety factor.

SOUTHERN CROSS (SCF) FORESTERS

Atlanta 8, Georgia • Melrose 4-4227

COMING EVENTS IN THE GAS DISTRIBUTION INDUSTRY

June

1- 3 Texas College of Arts and Industries, fifteenth annual Short Course in Gas Technology sponsored by the Southern Gas Association. Kingsville, Texas.

1- 3 Fifth Annual Appalachian Underground Corrosion Short Course, West Virginia University, Morgantown, West Virginia.

6- 7 PCGA-A.G.A. Research & Utilization conference, Miramar Hotel, Santa Monica, California.

8- 9 PCGA customer service conference, Miramar Hotel, Santa Monica, California.

13-15 American Society of Heating Refrigerating & Air Conditioning Engineers, annual meeting, Vancouver, Canada.

20-23 National Association of Plumbing Contractors, annual meeting, Cleveland, Ohio.

21 New England Gas Association, operating division, Worcester Polytechnic Institute, Worcester, Massachusetts.

22-25 Canadian Gas Association, 53rd annual meeting, Manoir Richelieu, Murray Bay, Quebec.

27-28 Michigan Gas Association, Grand Hotel, Mackinac Island, Michigan.

July

24-Aug. 5 Ninth Annual Utility Management Workshop, Arden House, Harriman Campus, Columbia University, Harriman, New York.

August

17-19 Mid-West Gas Association gas school and conference, Iowa State College, Ames, Iowa.

29-31 Appalachian Gas Measurement Short Course, University of West Virginia, Morgantown, West Virginia.

September

9 New Jersey Gas Association, annual meeting (place to be determined).

12-14 A.G.A. accident prevention conference, Leamington Hotel, Minneapolis, Minnesota.

15-16 A.G.A. Textile Processing Symposium, Sedgefield Inn, Greensboro, North Carolina.

15-17 Public Utilities Association of the Virginias, 42nd annual meeting, The Greenbrier, White Sulphur Springs, West Virginia.

18-21 ASME Petroleum Mechanical Engineering Conference, Hotel Jung, New Orleans, Louisiana.

21-23 Southeastern Gas Association, annual meeting, Sir Walter Hotel, Raleigh, North Carolina.

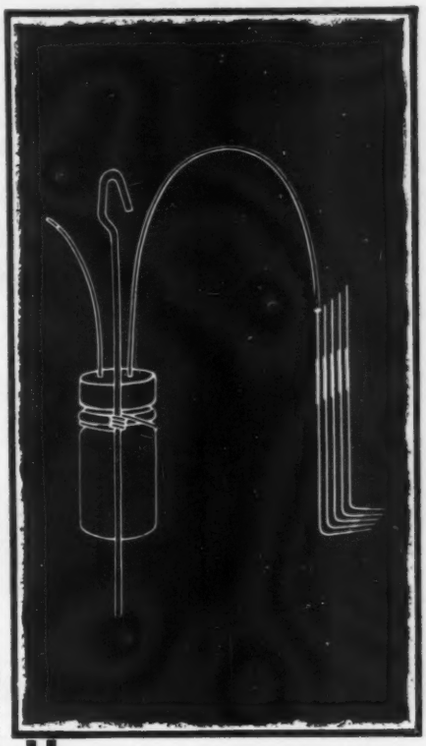
21-23 PCGA annual meeting, Westward Ho Hotel, Phoenix, Arizona.

23 Oklahoma Utilities Association, gas division, Biltmore Hotel, Oklahoma City, Oklahoma.

October

5- 7 Wisconsin Utilities Association, annual gas operating and sales convention, Schroeder Hotel, Milwaukee, Wisconsin.

CANNON PENS



UP TO A YEAR WITHOUT REFILLING

Cannon Meter Pens are easily installed as original or replacement equipment in all standard recording instruments. Produce accurate charts of maximum legibility. No blurring or smearing.

- Ends unrecorded intervals. Unaffected by pulsating flows, chart speeds, or rapid pen movement.
- Sealed ink supply prevents clogging from atmospheric contamination.
- Two-way capillary action ink flow eliminates smearing, blurring.
- Available in five sizes and angles. Special pens designed to customer specifications on request.

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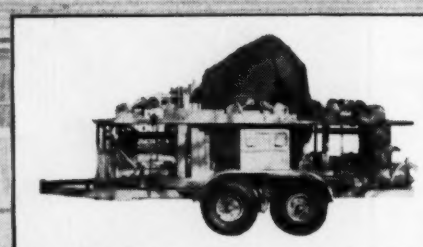
NOW! A portable high-speed taping machine for Polyken cleans, tapes and w



In road-ready position, unit is compact and completely mobile. Comes on 4-wheel tandem trailer or on steel skids. With 80 feet of pipe-handling trackage.

New Polyken tape method handles ¾" to 4" pipe, cleans and coats 2,500 feet per hour and sets up anywhere

Probably the best thing about the Betzel taping machine and Polyken tape is the absence of all the nasty problems of hot dope. The highly mobile "Betzie," developed jointly by Polyken and A. E. Betzel, sets up in an hour (comes down in half the time).

With only 6 men, or less, you run a continuous cleaning, coating and wrapping operation that processes 2,500 lineal feet per hour. Takes only 10 minutes to switch pipe sizes. And the savings? Well, just compare the time, labor, and small investment against the average hot dope operation.

The practical Polyken way

With Polyken tape you know the coating is always ready. Goes on factory-smooth, too. No primer, no drying or cooling time. No fumes or fire hazards.

What's more, permanent Polyken tape can take almost anything—as already proved by its many hundreds of miles and years of hard work. It's being used in such tough terrain as the

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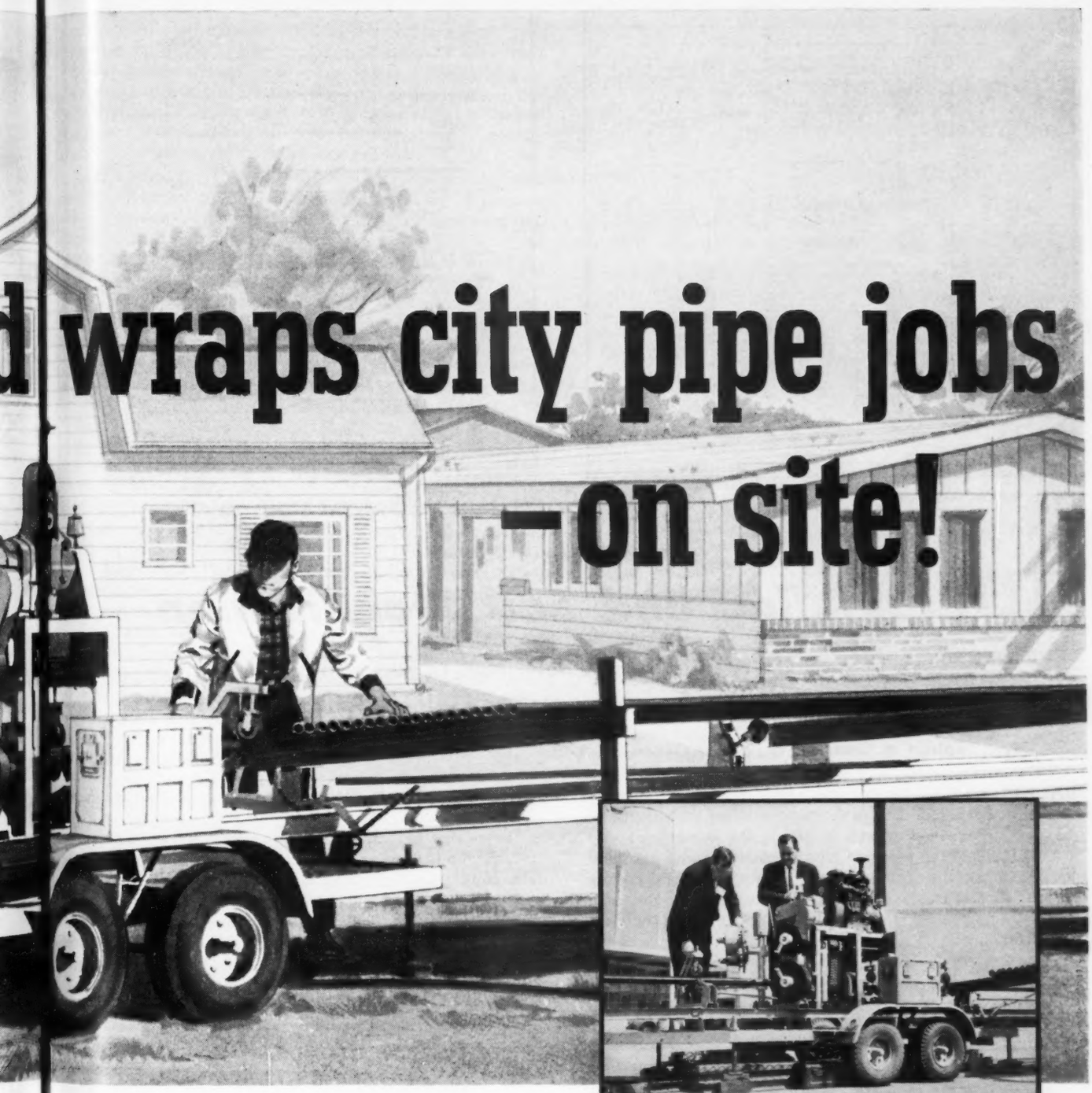

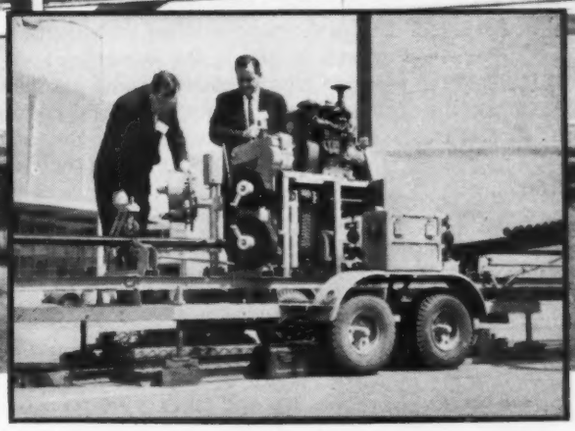

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As the pipe spins through the "Betzie," twin powered brush heads afford dynamic cleaning—as shown in this demonstration at the 1960 N.A.C.E. meeting in Dallas, Texas. Other standard equipment includes twin brake-type tape and outer wrap spindles for rapid change of rolls, and an adhesive attachment for fast-gluing outerwrap.

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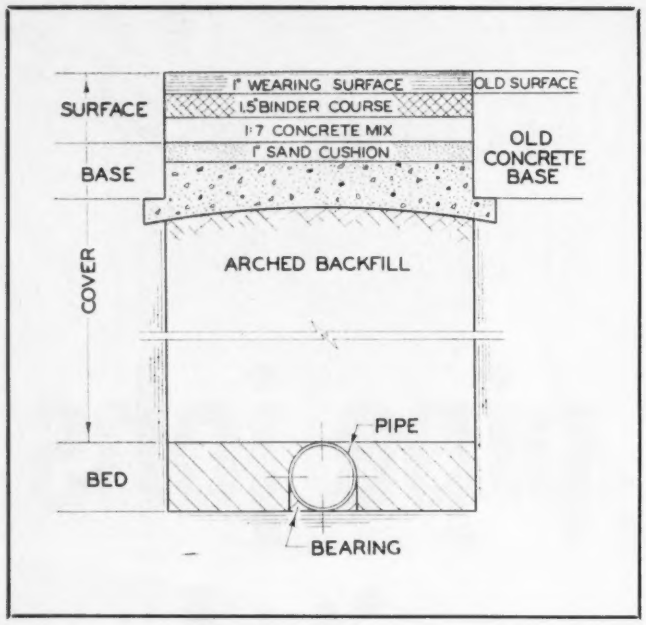


Fig. 1. Section through backfill.

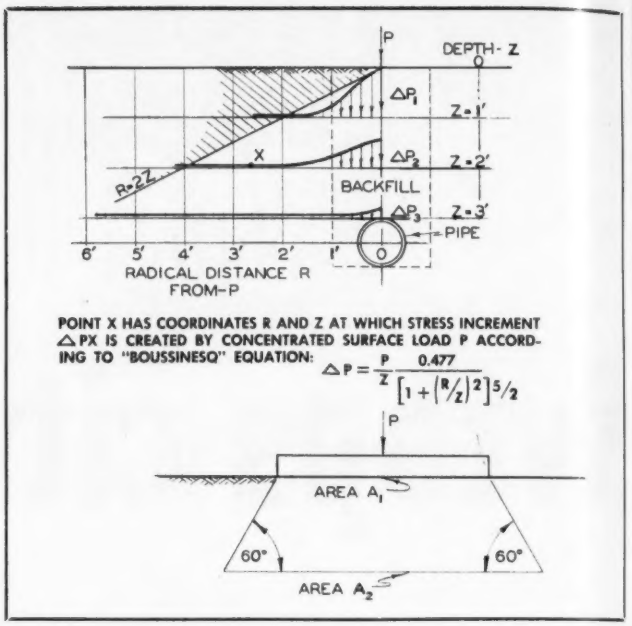


Fig. 2A. (Top) Vertical and horizontal stress variation due to point load.
Fig. 2B. (Bottom) 60° Approximation distributed loading.

Backfilling and Soil Stabilization

Are your backfill operations up to date? Modern gas main and service line construction requires adequate knowledge of soil mechanics

Robert H. Ormston, *Gas Operating Department, The Union Light, Heat and Power Company, Covington, Kentucky*

BACKFILL for a large diameter sewer recently installed by a contractor failed. The sewer was installed at a depth of 10 ft in an excavation laterally along the center of a city street. The sewer excavation paralleled an existing gas main located inside the street, adjacent to the curb and having service laterals traversing the sewer excavation from main to curb. The backfill was bankrun, complying with the local city ordinance.

An explosion occurred in a residence located along the construction. The residence was almost totally destroyed and several persons were critically injured. A suit for damages has been initiated.

An investigation disclosed the following:

1. *That the explosion was caused by ignition of gas entering the basement of the residence.*
2. *That the source of the gas was from broken service laterals crossing the excavation. These were six in number.*
3. *That the service laterals failed due to a 6-in. settlement of the bankrun backfill, which was not tamped or jetted into place.*

Such severe failures are, of course, not common; however, they occur often enough to indicate the need for careful scientific soil engineering, even on the smallest construction job.

In the foregoing instance, an elementary basic understanding of soil behavior may have prevented the incident in addition to saving a considerable amount of expense. In all probability, the attitude taken by the contractor was one of complete disregard for the property of the utility. Also, one of complacency in the fact that if settlement did occur he would add more bankrun.

Traditionally, backfilling receives, at best, only the most casual attention. The old-fashioned idea of pushing dirt into a trench and letting nature take its course is an invitation to trouble.

There are too many of us engaged in excavating who feel the job is done as soon as the pipe is laid. We may actually think that backfilling is an incidental operation to be done by the lowest paid help. More often than not the blame is apt to be put on the technique used when it really deserves to be placed on poor workmanship. We must recognize the importance of using trained and interested help in the backfilling operation.

A stable backfill is an important consideration in gas main construction. This importance is derived from:

1. *A stable backfill forms the base for surface restoration.*
2. *A stable backfill protects underground structures from mechanical failure.*

Surface Restoration

Each surface restoration class (Table 1), like other structures, must be supported by a foundation. If the foundation fails through settlement, the surface restoration is no longer serviceable and must be repaired. The surface area involved may be a single street opening, or may be several hundred feet of trench. In any event, the responsibility for repair and any damage and/or injury incurred due to settlement of the restored area must be borne by the agency making the excavation.

Modern day, uncongested traffic flow demands that closure and surface restoration keep a pace with construction. This can and does in some cases apply even if the work is not completed in a specific interval of time. Peak traffic flows may require temporary bridging. Closure may be, simply, a steel bridge over the excavation or a temporary backfill to be re-excavated, or a permanent backfill with temporary

surfacing, or a permanent backfill with a permanent surface.

It is usually found that it makes little or no difference whether closure and surfacing is temporary, partially temporary, or permanent in nature. The community imposes the same rigid set of standards. The term "temporary" is limited to the restoration surface, since by any service or economic standard, a temporary backfill does not exist.

Large cities usually perform their own surface restoration by means of city crews or contractors. Cost of permits for excavation includes the cost of surface restoration and varies according to class and type of services desired. Restoration services offered by cities are of the following types.

1. **Complete restoration.** City forces excavating and disposing of temporary surface, placing a concrete base or other base adequate for the purpose, and installing the pavement complete.
2. **Surface restoration.** Concrete base, or other base adequate for the purpose has been installed by contractor forces in accordance with specifications. Paving surface to be restored by city forces.
3. **Special surface restoration.** Permittee has installed a concrete base and has made temporary surface restoration. Concrete base is uniformly placed 2½-in. below street surface. Surface is a temporary bituminous concrete which will be allowed to remain in place, serving as a binder for final sheet asphalt surface that will be installed by the city.
4. **Inspection.** The entire restoration, both base and surface, has been performed by permittee, under the direction and to the satisfaction of city officials.
5. **"Force Account" or "Cost Plus."**

Smaller communities not having these services are entirely dependent upon the excavator for the performance of surface restoration. The only requirement being adherence to local specifications and applying the same class of surface and base as initially found. Exceptions being that Class 2 pavements (brick, granite, durex, woodblock) would be replaced by concrete.

In localities where average temperatures of less than 40F occur, production of hot mix bituminous concrete is curtailed. A cold applied, pressure sensitive bituminous concrete is substituted and gives satisfactory performance as a temporary and/or permanent surface.

Protection of Underground Structures From Mechanical Failure

Strength is the ability of a pipe to resist, without failure, stress producing forces. Strength considerations are usually

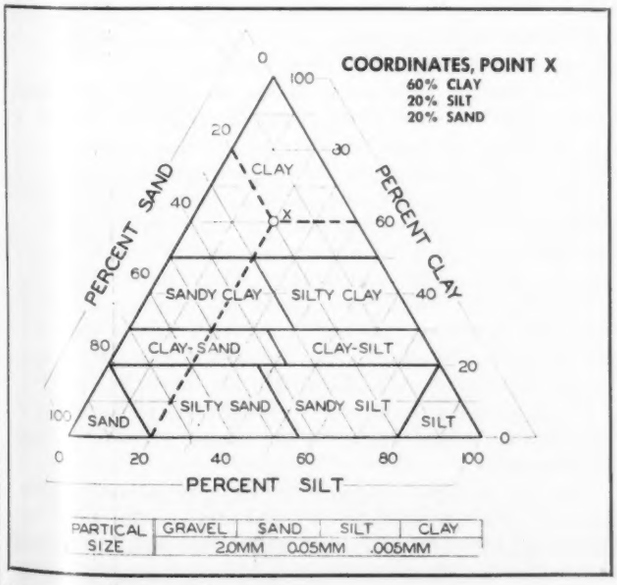


Fig. 3. Triangular chart for textural classification of soils.

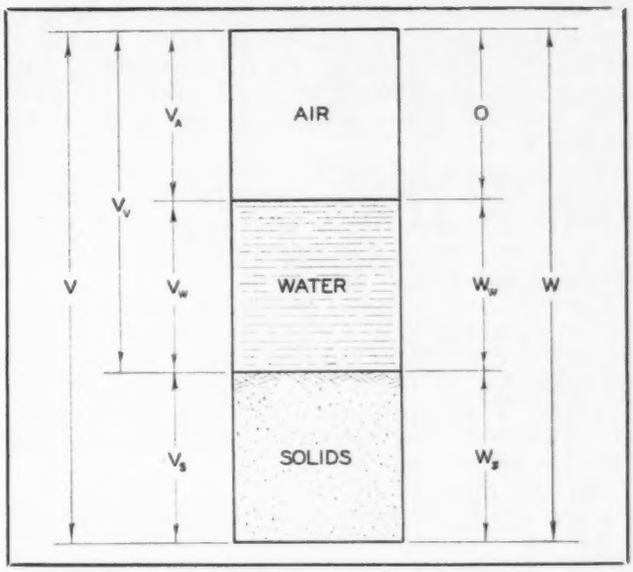


Fig. 4. Soil phase relationships.

taken into account by pipe manufacturers and include provisions for:

1. The effect of a crushing load produced by the weight of the backfill.
2. Variations of the crushing load transmitted to the pipe under different trench conditions.
3. A factor of safety based on hoop stresses resulting from internal pressure and external load.
4. An allowance for corrosion and manufacturing tolerances.

Forces acting upon buried pipe structures are usually termed **"external loads."** External loads are produced by and represent the combined effect of forces originating from:

1. The backfill — (includes soil body forces, soil seepage forces).
2. Surface loads — (includes weight of traffic, weight of structures, sudden impacts.)

External loads are transmitted through the soil environment to the pipe. External loads occur in sufficient magnitude to cause failure unless restricted or resisted.

Fig. 1 represents a typical cross section of a backfill showing a pipe laid in a trench excavation. The terminology used is more or less standard throughout our industry. The section shown applies to trafficked surfaces. For other surfaces the cover would be extended to ground elevation.

The outstanding functional property of a dense backfill is the protection of the pipe from surface loading. The protection is gained through a reduction in the magnitude of an applied external load. The relationship between depth of cover and incremental reduction of external loading **P** is shown in Fig. 2. This relationship represents stress increments due to concentrated point loadings and/or point load approximations. Such a condition would exist for all situations, excluding Class 1 and Class 4 pavements.

The Class 1 and Class 4 pavements are considered as continuous solid load bearing pavements and they represent conditions where stress increments are the result of a distributed boundary loading. This condition is not applicable to the *Boussinesq* equation (Fig. 2A).

It is a common practice to treat distributed boundary loadings by a method known as the 60° approximation (Fig. 2B). Here, surface loadings are assumed to be distributed uniformly over an area $\mathbf{A}_1$.

The loading at any subsequent depth **Z** is assumed to be distributed uniformly over an area $\mathbf{A}_2$. Area $\mathbf{A}_2$ is defined by planes descending from the edges or boundaries of $\mathbf{A}_1$

intersecting a horizontal plane in a 60° angle at depth **Z**. The load increment within these limits at any depth **Z** is the load **P** divided by area $\mathbf{A}_2$. For the usual cover of 3-ft, the stress reduction is not significant and no accuracy is lost if the stress distribution is simply the load **P** divided by the area $\mathbf{A}_1$.

The *Boussinesq* and the *60° Approximation* equations are independent of the nature of the soil. If the external loading, at any depth, exceeds the ultimate soil bearing capacity at that depth, soil settlement will occur having the possible consequence of pipe failure.

External loads transmitted through the soil to the pipe surface are resisted by pipe deflection, pipe distortion, and trench bottom conditions. The importance of the load bearing capacity of the trench and improper bearing between trench and bottom of the pipe cannot be over-emphasized. *Low soil bearing values between pipe and trench invite pipe deflection and pipe failure.*

Soil body forces are the vertical forces at any point in a soil formation. The forces result from the thickness and unit weight of the overlaying material. These forces increase in direct proportions with depth and tend to deform or compress the underlying soil stratum.

Soil seepage forces are the multi-directional forces resulting from the movement of gravitational water through the soil. As water moves, a drag is exerted on each soil particle, the magnitude of which is proportional to velocity of flow.

Properties of Soil

A very loose but adequate definition of soil would be "any unconsolidated material that can be excavated with pick and shovel." This certainly is an all inclusive definition and could equally be applied to small glacial boulders, swamp slime, and refuse of the city dump. A more exacting concept is a "heterogeneous" chaotic mixture of almost anything.

It is obvious that soil cannot be treated or analyzed by simple handbook data; soil must be recognized and treated as a unique substance requiring special study and special consideration.

Soil is universally classified by texture. Texture is a reflection of particle size and shape. There are three texture classification categories:

1. Sands; 2. Silts; 3. Clays

It is convenient to express all other soil mixtures in terms of the sands, the silts, and the clays. Rock and/or organic products are not considered primary soil components. Fig. 3 is a triangular method of classification developed by the U. S. Corps of Engineers whereby the boundaries of all possible soil admixtures are established.

The mineral sands, silts, and clays represent the solid phase of a three phase soil relationship, the remaining two phases being gaseous (air) and water. This three phase relationship is illustrated by Fig. 4.

The final combination of air, solid, and water determines soil structure. Soil structures can be placed in three basic categories.

1. **Single grained.** Typical of bulky particles exhibiting particle to particle contact (Fig. 5A), similar to the stacking of apples by the grocer either as (a) loose, that is one apple placed directly on top of its neighbor or (b) dense, one apple placed in the valley formed by its adjoining neighbors.

2. **Honeycombed.** Typical of the fine grained, bulky particles laid down in the still waters (Fig. 5B), the particles of which form arch-like chains that remain in place during settling as opposed to rolling or moving to a more dense and more stable position. Honeycombed structure is characterized by a high void ratio, a relatively stable structure, but extremely sensitive to shock, with break downs occurring suddenly as chain-like reactions converting the mix to a heavy fluid-like liquid.

3. **Flocculent.** Typical of the extremely fine grained soils. Structure originates from colloidal suspensions (Fig. 5C). Soil particles have large surface to thickness ratios and are charged electrically — settlement either edge-to-surface contact in flocs or parallel particle-to-particle. The distinguishing feature of this structure is a weak but continuous open framework with relatively large void passage.

Many natural soils occur in the three basic structures. Other soils occur in more complex structures similar to Fig. 6. In the complex mixtures, structure — together with particle size — determines the ultimate behavior of the soil.

For example, if the solid phase is large grained, having particles contacting each other and other smaller cohesive particles occupying the voids, the soil will behave as if it were composed entirely of large grained material (Fig. 6A).

On the other hand, if the coarser particles are suspended in a clay matrix and are prevented from having surface to surface contact by the matrix (Fig. 6B), the soil will behave as if it were composed of entirely fine particles.

Other noteworthy properties of soil that are deserving of consideration in this limited space are *soil permeability* and *soil strength*.

The void or open spaces in the three phase soil relationship, occupied by all of the air and some of the water (we cannot say all of the water for reason that will be seen in a later section) are termed the voids. Soil voids are not isolated spaces. Soil voids are interconnected and form passages

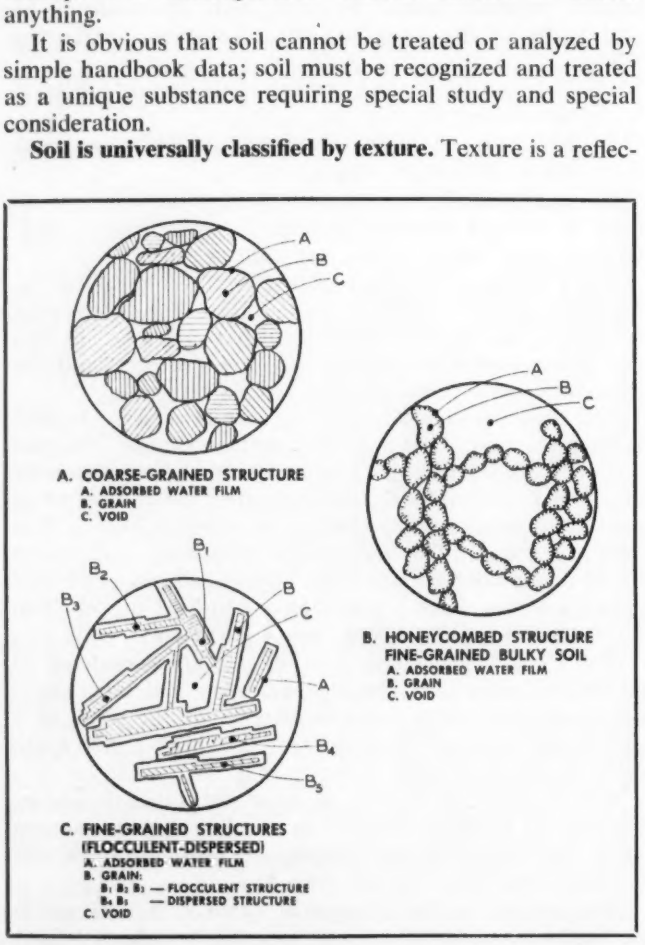


Fig. 5. Structure of natural soils.

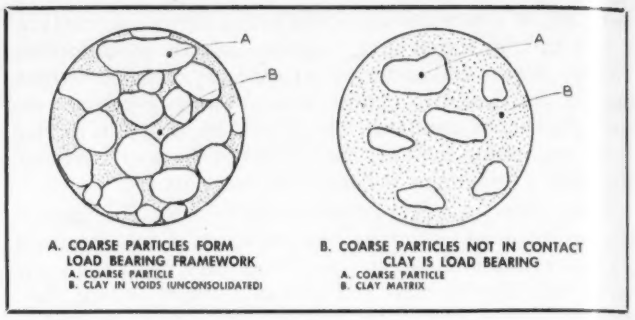

A
B
A. COARSE PARTICLES FORM LOAD BEARING FRAMEWORK
A. COARSE PARTICLE
B. CLAY IN VOIDS (UNCONSOLIDATED)
B. COARSE PARTICLES NOT IN CONTACT CLAY IS LOAD BEARING
A. COARSE PARTICLE
B. CLAY MATRIX

Fig. 6. Structure of mixed soils.

through which gravitational water can flow. The soils' ability to permit such water flow is a measure of its *permeability*. Soil permeability is important since it determines the time rate at which the soil reaches its ultimate compression.

It has been stated several times that soil is a combination of three distinct phases—solid, liquid, gaseous. The relationships between the three phases are continuously changing. Soil, unlike other more familiar engineering materials, is not a solid and is not a liquid. It is necessary to recognize that *strength* at a point in the soil formation is not singularly dependent upon the properties of one material; rather, soil strength is determined by the property of more than one material. The influence of these properties varies with time.

Cohesionless soils, which include all of the sands and some of the silts, derive their strength through internal friction between particles. The magnitude and direction of the principal stress acting on a single particle is the resultant stress, formed by the combination of the vertical normal and tangential sheer stress. The oblique angle of the resultant, measured from the normal (vertical), is indicative of the relative magnitude of the resultant stress and therefore the ultimate strength. When the value of this angle reaches a maximum, failure will occur. The friction angle of a cohesionless soil is equal to the maximum angle of obliquity of the resultant.

The soils exhibiting cohesion, including all of the clays and some of the silts, do not derive their strength through internal particle friction (particles not in particle to particle contact) but rather, derive their strength through resistance due to cohesion. Cohesion is a property that, like viscous friction, varies with liquid consistency.

Due to the differences in structural arrangements, a fixed relationship between the tangential and normal stresses at failure does not exist. The magnitude of stress at failure is approximately equal to the unit cohesion, regardless of the value of the normal vertical and tangential stress.

Rather than resorting to the unit cohesion as a strength index, it is common practice to correlate strength with unconfined compression test results. An *unconfined compression test* is made simply by applying an axial load to a clay cylinder that has no provision for lateral support.

Soil Moisture

Moisture is always present in soil. The behavior of a soil is largely determined by its moisture content. The two primary sources of soil moisture are:

1. *Capillary rise from the water table.*
2. *Gravitational movement of water through soil voids.*

Moisture from the two primary sources can be termed: 1. *Chemical or molecular.* 2. *Adsorbed.* 3. *Free.*

The term *chemical or molecular* refers to the water that is chemically combined with soil minerals.

The term *adsorbed* refers to the water held immobile on the surfaces of the soil elements.

The term *free water* refers to the water moving through the soil voids under the influence of gravity or pressure differences.

Because of the important role played by the adsorbed water film in the behavior of soil, it is necessary to gain a knowledge of its origin.

Soil particles are inherently charged negative. The magnitude of the charge is dependent upon the chemical composition and surface molecular structure of the grains. Molecules of water can be thought of as being polar in nature. Water molecules are attracted to the soil particles where they are held immobile by the surface charge of the particle. The layer of water surrounding the soil particle is termed the adsorbed water film.

Thickness of the adsorbed water film is dependent upon the availability of water in the soil and the magnitude of the surface charge of the soil particle. The layers of water molecules in close proximity to the grain surface assumes the properties of a solid. The more remote layers exhibit the properties of a viscous liquid or glue.

Forces associated with the adsorbed water film play an important role in the determination of physical properties of the fine grained soils but have little effect on the properties of coarser soils.

Soil Stabilization

With a limited but basically adequate knowledge of soil behavior we can now fully appreciate with some degree of understanding the most important of all backfilling considerations—*soil stabilization.*

The term stabilization is used with reference to the various procedures used to improve soil behavior characteristics and represents man's efforts to make soils conform to some minimum standard.

There are two distinct categories of consideration:

1. *Mechanical stabilization.*
2. *Chemical stabilization.*

Mechanical Stabilization

Compaction is the resulting effect when a pressure or force is applied to a soil. In its most general sense, compaction means bringing the soil particles close together, thus increasing the density of the soil. *Density* is a measured weight per unit volume. *Soil density* is the measure of dry weight per unit volume of the soil. Four density variables must be considered.

1. Moisture content.

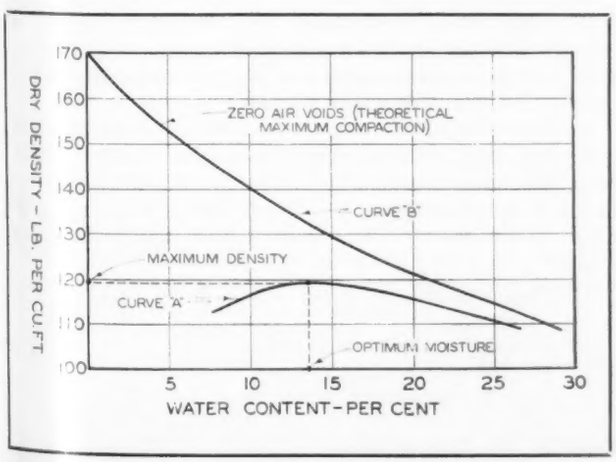


Fig. 7. Moisture-density relationship.

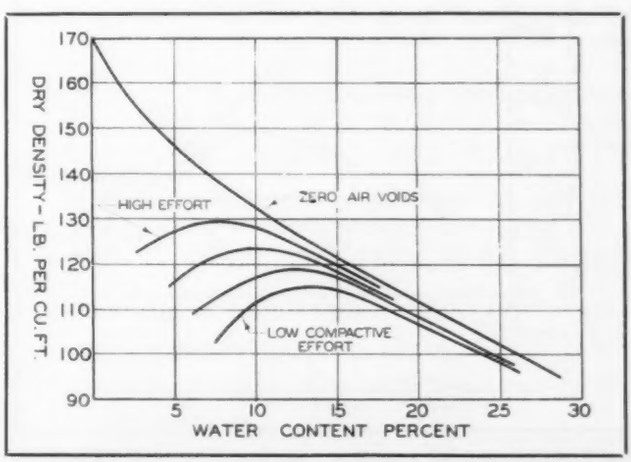


Fig. 8. Effect of compaction effort on moisture-density relationship.

2. Unit density.
3. Compaction effort.
4. Soil type and gradation.

Moisture has a marked effect in soil density relationships. For a given moisture content, the density varies with the compaction effort (Fig. 7). Compaction effort can vary with type and kind of mechanical compactor chosen, number of passes per backfill layer, speed of forward motion, energy expended. Conversely, at a given compaction effort density can be related with moisture content. At a given moisture content and at a given compaction effort, coarse grained and fine grained soils will respond differently.

On Fig. 7, curve A is a plot showing the *moisture-density relationship at a specific compaction effort*. Curve A represents actual behavior and is usually referred to as the *Proctor* curve. Curve B (Fig. 7) is a plot of the theoretical maximum density or, as it is usually referred to, the *zero air void curve*.

The zero air void curve is theoretical and represents perfect compaction at any given water content. If all the air is expelled from a soil, the soil is 100 percent saturated.

Note that curve B lies above curve A at all times. At the higher moisture contents, the dry densities are low as the water occupies much of the soil volume. At lower water contents the theoretical dry density increases. At the higher moisture contents, the actual and theoretical curves appear to be parallel; at the low moisture contents, however, there is a significant difference. This difference is caused by the very viscous adsorbed water film surrounding the soil particles to the extent that it interferes with particle movement over adjoining particles.

In effect, soil tends to resist compaction. The optimum is represented by a compromise—enough water to act as a lubricant and allow the grains to compact easily but not enough to restrict movement thereby limiting the volume of the soil.

Each soil exhibits an optimum for a given compaction effort. Differences in compaction effort will result in different optimum points (Fig. 8). Generally, the greater the compaction effort the lesser will be the optimum moisture content and the greater the maximum dry density. Optimum moisture is not an inherent property but depends on the method of compaction.

When the water content is relatively high, the inefficiency of the compaction process is readily observed in the field, since the compaction effort tends to displace the soil instead of compressing it. Compaction on the low moisture side is not so obviously inefficient and, actually, the results appear satisfactory and compaction equipment operates with

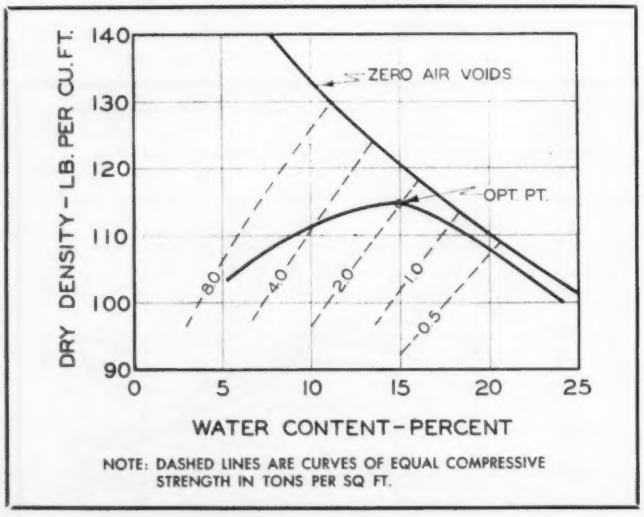


Fig. 9. Relationship of unconfined compressive strength to moisture content and density.

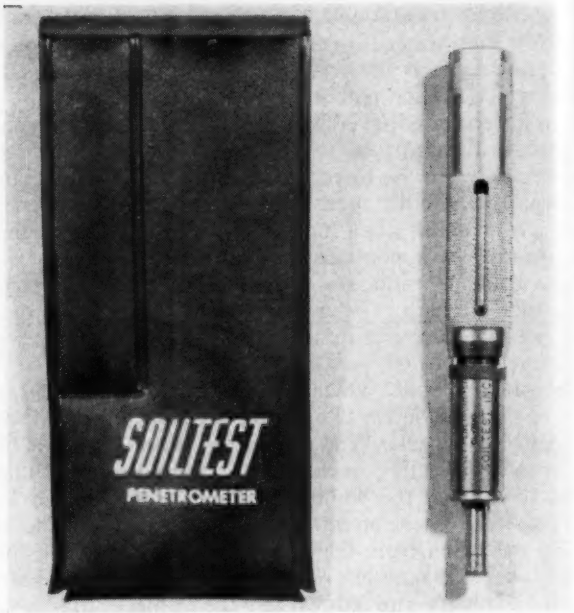


Fig. 10. Simple penetrometer aids in obtaining unconfined compressive strength values.

less difficulty to the extent that many operators erroneously tend to prefer this condition.

Fig. 9 relates moisture content with strength for average clays. Unconfined, compressive strength values can be easily obtained in the field using a simple penetrometer (Fig. 10).

Soil texture also plays an important role. The foregoing discussion of optimum compaction was descriptive of a fine grained cohesive soil such as clay. Granular or cohesionless soils, the sands, become most dense when their grains assume new positions that reduce the void spaces between them. Pressure is almost useless.

Vibration accompanied by light pressure is most effective. A severe shock or a series of harmonic repetitive shocks produced by impact of a heavy object can increase the density of cohesionless soils at several feet depth. Cohesionless sands slightly moist will exhibit a reduction in sensitivity to vibration. Capillary tension acts to restrict free movement of the grains. Complete water saturation, however, will eliminate capillary tension and permit compaction.

Slightly cohesive soils (silts) are more readily compacted by a pressure that squeezes the grains together. If the pressure is too great, the soil will fail in shear, producing a loose backfill. An alternate for slightly cohesive soils that is very effective is complete saturation. During the dry-out, the force due to capillary tension will act as compaction effort.

The disadvantage of flooding should be carefully considered, unless one is **absolutely** sure of the permeability of the parent material. The flooding of backfills where parent soils have poor permeability will result in extremely erratic compaction with soft soupy pockets.

As mentioned before, a cohesive soil must be mechanically stabilized using a compaction effort of considerable magnitude. Mechanical compaction equipment suitable for use in gas construction must be of such design that the equipment can be used in close quarters. Such equipment would include:

1. Hand pneumatic tampers single or in gangs of three — air driven.
2. Gasoline operated soil ramers.
3. Tractor-type backfill tampers.
4. Trench rollers (not widely used).

Control of Compaction

Compaction control is essentially an inspection operation.

This includes on the spot observation of the entire backfill procedure to determine:

1. *Suitability of the soil used in backfill* — rock free — remove from construction site and replace if necessary.
2. *Suitability of the backfill soil moisture content.* Add water if too low. Aerate or replace if too high.
3. *Degree of compaction effort required.* Determine thickness of compaction layers, number of passes, speed of advance. Adjust compaction effort in accordance with moisture content.

Other control measures are:

1. *Inclusion of rigid specification for backfilling in contract work.*
2. *Education of work forces in basic soil mechanics.*
3. *Use in field of special equipment to obtain density readings.*

Remedial measures in the event soil conditions are not consistent with good backfill procedures are basically three in number.

1. Change moisture content.
   a. Addition of a water to soil if too low.
   b. Aeration of soil if too high.
2. Change compaction effort.
   a. Addition or deletion of weights.
   b. Increase or decrease number of passes.
   c. Decrease compaction layer thickness.
   d. Decrease forward travel.
3. Change soil.
   a. Carry away all or partial of parent fill and replace from barrow.
   b. Purchase from an outside source a more suitable material.

Chemical Stabilization

Chemical stabilization is not a separate solution. Its primary use is to make the mechanical methods more lasting. The expense of chemical soil stabilization usually precludes its every day use. Chemical stabilization includes:

1. **Soil cements.** Admixtures of portland cements or fly ash distributed on the surfaces of the backfill in predetermined quantities.
2. **Bituminous binders.** Distributed uniformly throughout the soil, decreases soils sensitivity to water in addition to binding grains.
3. **Water proofing admixtures.** Vinyl resins prevent changes in moisture content.
4. **Deliquescents.** Prevents drying out and soil shrinkage.

Soil Settlement

Settlement of a backfill will always occur if a soil is placed in an excavation in a state of compression that is not at least equal to that of the surrounding parent soil.

Under the compressive action of static loading, natural forces, and under favorable changes in soil structure (but always in a finite period of time) a backfill will tend to seek its ultimate state of compression. Soil under compression will exhibit a change in the volume of soil voids thereby increasing the density of the soil. Soil voids for the most part are filled with free water, the removal of which requires a definite interval of time. The effect of the full compression cannot take place until the void water has been removed. The process of becoming more dense in increasing time is known as consolidation.

Fig. 11 is a simple illustration of consolidation. The spring **"A"** represents soil solids. The solids are surrounded by water forming a two phase relationship. Initially the load **L** is supported partially by the water and partially by the spring. The system remains static if — and only if — the water is contained.

In the event the water is allowed to escape through valve

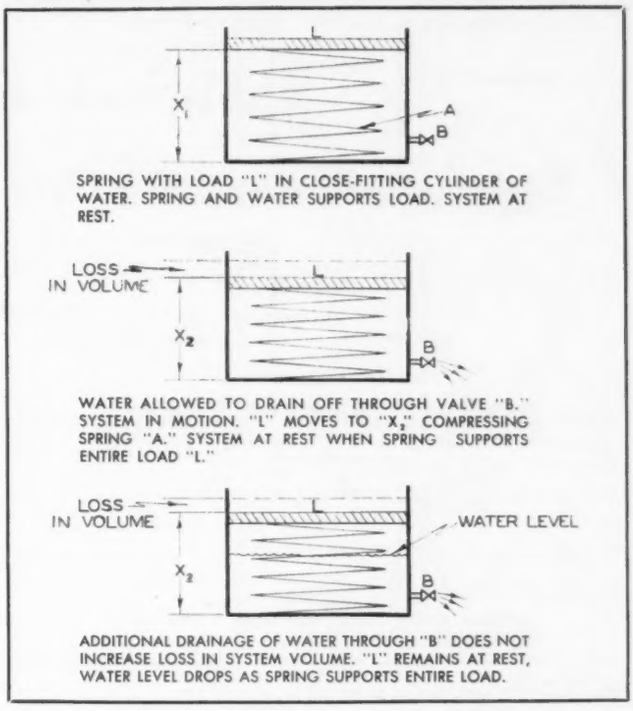

L
X_1
A
B
SPRING WITH LOAD "L" IN CLOSE-FITTING CYLINDER OF WATER. SPRING AND WATER SUPPORTS LOAD. SYSTEM AT REST.
LOSS IN VOLUME
L
X_2
B
WATER ALLOWED TO DRAIN OFF THROUGH VALVE "B." SYSTEM IN MOTION. "L" MOVES TO "X_2," COMPRESSING SPRING "A." SYSTEM AT REST WHEN SPRING SUPPORTS ENTIRE LOAD "L."
LOSS IN VOLUME
L
WATER LEVEL
X_2
B
ADDITIONAL DRAINAGE OF WATER THROUGH "B" DOES NOT INCREASE LOSS IN SYSTEM VOLUME. "L" REMAINS AT REST, WATER LEVEL DROPS AS SPRING SUPPORTS ENTIRE LOAD.

Fig. 11. Piston and spring analogy illustrating consolidation of soils.

B a reduction in the system volume occurs at a rate that is entirely dependent upon the rate that the water is allowed to escape. The compression of the spring is analogous to increasing the density of the soil. A point will be reached at which the load **L** will be supported by the spring compression. The system will again be at equilibrium, with the entire load **L** supported by the spring. Allowing additional water to escape will not produce an additional change in spring compression.

Consolidation is the inevitable result of a continued applied force resulting from:

1. Capillary action.
2. Soil body forces.
3. Surface loading.

Best evidence of capillary action is the vertical movement of water up a small diameter tube. The force exerted by this movement must be balanced by a compressive force on the walls of the tube. If the walls of the tube are the resilient grain structure of the soil, the walls will compress to a point where the capillary force is balanced by the resistance of the wall. If the grains are free to move under the action of the capillary force a change in soil volume will occur.

Water moves upward through the soil by means of capillaries formed by the individual grain boundaries. The movement is usually upward from the water table or free water surface toward the soil surface. The height of the capillary water column above the water table is dependent upon the grain size of the soil. In cohesionless sands the rise is only a few inches while in a cohesive clay the rise may be as great as 60 ft.

The amount or percent of consolidation that will occur is dependent upon:

1. **Soils permeability,** which governs the flow rate of the water.
2. **Thickness of overlying strata,** which governs the volume of water as well as the distance water must travel.
3. **Number of previous boundaries of stratum.** This influences distance the water must travel.
4. **The void ratio and the rate of change of the void ratio with pressure.** This influences both volume of water and the change in soil volume with loss of water.

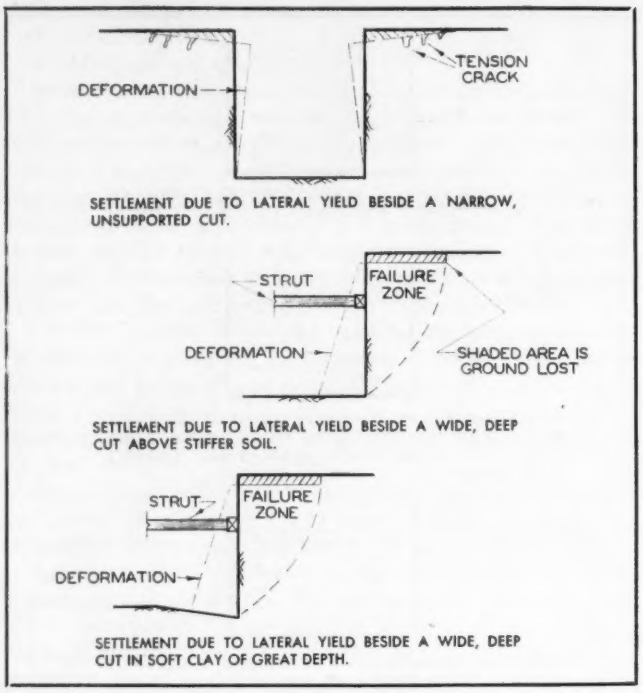

DEFORMATION
TENSION CRACK
SETTLEMENT DUE TO LATERAL YIELD BESIDE A NARROW, UNSUPPORTED CUT.
STRUT
FAILURE ZONE
DEFORMATION
SHADED AREA IS GROUND LOST
SETTLEMENT DUE TO LATERAL YIELD BESIDE A WIDE, DEEP CUT ABOVE STIFFER SOIL.
STRUT
FAILURE ZONE
DEFORMATION
SETTLEMENT DUE TO LATERAL YIELD BESIDE A WIDE, DEEP CUT IN SOFT CLAY OF GREAT DEPTH.

Fig. 12. Settlement due to construction operations.

Soil Settlement Due to Construction Operations

Sub-surface facilities such as mains and service laterals located in close proximity to other major sub-surface construction may be adversely affected by soil settlement. Open cuts in soils cause settlement of the soil immediately adjacent to the excavation. The magnitude of such settlement is dependent upon one or more of the following factors:

1. Kind, type, and structure of the parent soil.
2. Depth and width of the excavation.
3. Amount of lateral bracing used and care with which it is placed.
4. The magnitude and proximity of surface loading (surcharge).

Settlement results from the failure of the soil comprising the free standing sides of the cut. A lateral, inward deformation of the free standing side walls occurs due, principally, to the soils body forces. The surface soil immediately adjacent to the excavation is affected for some distance outwardly and laterally. The zone where ground lost due to settlement is most probable can be related to the depth and width of the cut.

A shallow trench that is not supported laterally will, under one or more of the conditions outlined above, fail as a soil wedge tending to rotate about its bottom (Fig. 12A).

On the other hand, a relatively deep excavation that has lateral support during construction by struts, and after construction by a backfill, can not rotate about its bottom; therefore, the soil must move vertically downward, as in Fig. 12B. All movement occurs at the bottom of the cut.

Open Cuts in Cohesionless Soils

Soils of this type carry surface loading by particle to particle contact. Stability is the major concern. Stability is dependent upon the soil friction angle and amount of saturation, making it almost mandatory to install lateral bracing even for shallow cuts. Because of the ability of a cohesionless soil to carry surface loading without lateral deformation, the settlement zone is usually limited to within one-half the depth of the cut.

Open Cuts in Soft Clay

Soft clay located at the sides of a cut acts as a surcharge or surface load. Under the action of the surcharge, the clay near the bottom of the cut yields laterally toward the excavation (Fig. 11C) and the bottom of the cut rises resulting in a general settlement of the ground located above the yielding clay.

It has been found that the magnitude of the lateral movement and corresponding settlement is dependent upon:

1. Width of cut to depth of cut ratio.
2. The construction procedure employed.
3. The presence and the depth of soft clay beneath the bottom of the cut.

If a cut is very narrow — i.e., width does not exceed depth, or if the bottom of the cut is located close to the surface of firm soil — the lateral movement or yield spreads a short distance from the sides of the cut and is restricted to a relatively narrow belt located on each side of the cut.

If the cut is wide or if the clay is soft to a great depth below the bottom of the cut, the lateral yield and corresponding settlement may extend to a distance considerably greater than the depth of the cut, regardless of the care with which the sides are braced.

Summary

Today, a large percentage of the annual funds allocated for highway construction and street improvement is being earmarked for highway and street maintenance work. The trend in future years can only be toward higher allocations. Community officials can foresee the time when maintenance of existing and future freeways, together with many new streets, will require the major portion of highway appropriations.

Foresighted cities are beginning to initiate stringent legislation directed toward a more rigorous approach to the backfill problem. Existing and future legislation in many areas include, as backfill requirements, such factors as 90 percent relative compaction, mandatory mechanical compaction, and use of sands and bankrun exclusively as backfill media. At the same time, city engineers — for the most part — are reluctant to act hastily as costly backfilling requirements are also applicable to public works projects and are certain to reflect in higher bids.

A compromise appears to be in order. The utility excavator has a definite responsibility to the motoring public for satisfactory backfill performance. At the same time, the utility company also has an equal responsibility to its owners and community rate payers to assure that the work is done at the lowest possible cost.

Actually, no community or organization can benefit under an unnecessary and unreasonable stringent backfill requirement. This is particularly so when special material methods and tests are imposed in lieu of cheaper but equal satisfactory performance from other types of materials and methods.

Through what means can we gain reasonable backfill standards and specifications? Through education — in particular, educating at all levels the men actively engaged in the excavation and backfilling process.

This education should be directed toward imparting

1. Importance of work;
2. Interest in the work;
3. Skill to do the work;
4. Knowledge required for the work.

The complexities of soil mechanics can be reduced and visually demonstrated to any degree and at any level of supervision and labor.

The rewards of such an undertaking are most gratifying.

Acknowledgment

This article adapted from a presentation made at the 1960 A.G.A. Operating Section Distribution and Transmission Conference, New Orleans, Louisiana. * * *

Should Stub Services Be Installed Ahead of Street Paving?

Robert L. Bulot, *New Orleans Public Service, Inc., New Orleans, Louisiana*

SUCCESS OF A STUB SERVICE PROGRAM depends upon the ability to determine not just that a gas service will be needed, but more specifically, when it will be needed.

Stub services are useful only during the period when street paving is relatively new. After several years, when the newness is gone, normal service installations can be made provided local ordinances permit. Our problem, then, is to determine those sites along a street to be paved that will require gas service during this period when it is not desirable to break paving.

Unfortunately, this is not an easy task. Generally, information needed to help make this decision is not available. This means that most cases have to be decided by guesswork alone. If our guesswork is such that proper provisions are not made, and new paving has to be cut frequently, then we can expect a great deal of trouble from local authorities. This usually causes considerable public criticism, too, particularly when property owners have shared directly in the cost of paving.

On the other hand, if we provide too many stubs, we will find them in the system years later — still unused. In addition to the original cost, this adds to maintenance and investment costs for as long as they remain. It is desirable, therefore, for economic reasons as well as for good public and political relations, to plan as wisely as possible for the installation of stub services.

The City of New Orleans has no specific requirements, or penalties, regarding a time limit before it is permissible to cut a newly-paved street. In this connection, New Orleans Public Service has endeavored to make provisions to avoid the cutting, except in emergencies, of fully paved streets (reinforced concrete with or without asphalt surfacing) within a period of five years after paving, and to avoid the cutting of blacktopped streets (asphalt surface on compact shell base) within two years after the application of blacktop. We believe that this is a reasonable length of time and that any cuts after this time lapse would be acceptable to everyone concerned.

Studies Prove Revealing

To get a clear picture of our experience at Public Service with the extension of stub services installed ahead of street paving, a study was made of all the extensions, additions, and retirements of stub services during the period of time from 1940 to 1958.

The time lapse from installation to extension was tabulated and an analysis made of the findings. Also, a two year period of time, 1949 and 1950, was analyzed separately. During these two years a large paving program was in progress and special attention was given to the selection of stub service installations. The results revealed by the studies indicate not only fewer stub extensions than expected during the first five years after installation, but fewer extensions even in later years.

In 1940, an inventory was taken of underground gas facilities and it was established that — as of January 1, 1940 — there was a balance of 3605 unused stubs in the system. Between 1940 and 1958 an additional 782 stubs were installed, which made a total of 4387 stub services that could be extended to customers.

It was not possible, without lengthy research that time did not permit nor justify, to determine what disposition was made of stub services prior to 1940. Beginning in 1940, however, the method of reporting the installations, extensions, and retirements of stub service installations for the keeping of property records was such that an accurate computation could be made. It was for these reasons that the 19-year period from 1940 through 1958 was selected for study.

Few Stubs Really Used

During this 19-year period 1762 stub services were extended to meter locations. (See Fig. 1.) This is only 40 percent of the 4387 stubs that were available for use during this time. In analyzing the 1762 stubs that were extended, it was found that only 12 percent of them were between one and two years of age when extended, and only 8 percent were between three and five years of age when extended. So only 20 percent were extended within five years after installation.

This means that 80 percent of these extensions were later performed during a period when it would have been ac-

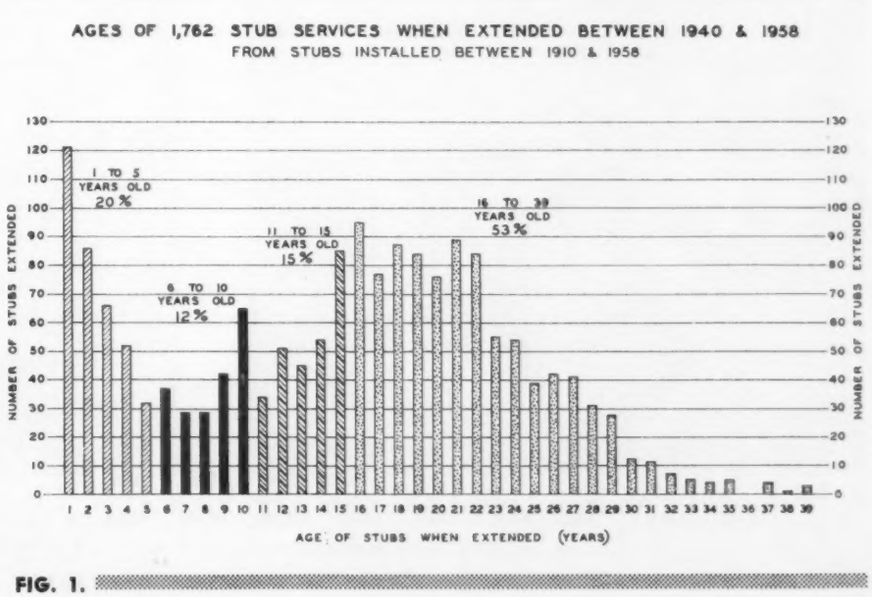

AGES OF 1,762 STUB SERVICES WHEN EXTENDED BETWEEN 1940 & 1958
FROM STUBS INSTALLED BETWEEN 1910 & 1958
1 TO 5 YEARS OLD 20%
6 TO 10 YEARS OLD 12%
11 TO 15 YEARS OLD 15%
16 TO 30 YEARS OLD 53%
NUMBER OF STUBS EXTENDED
AGE OF STUBS WHEN EXTENDED (YEARS)

FIG. 1.

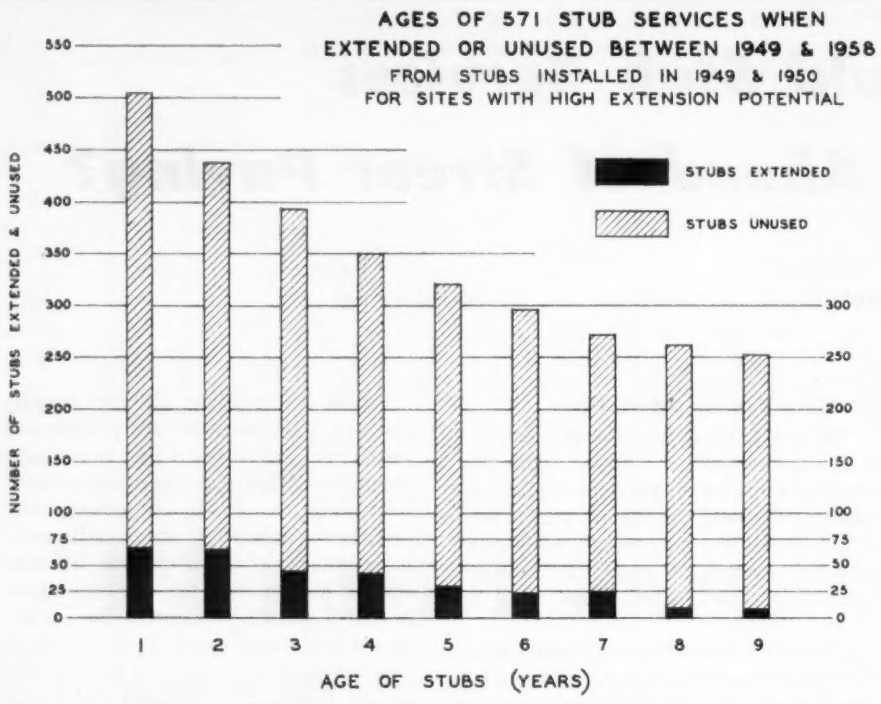

AGES OF 571 STUB SERVICES WHEN
EXTENDED OR UNUSED BETWEEN 1949 & 1958
FROM STUBS INSTALLED IN 1949 & 1950
FOR SITES WITH HIGH EXTENSION POTENTIAL
STUBS EXTENDED
STUBS UNUSED
NUMBER OF STUBS EXTENDED & UNUSED
AGE OF STUBS (YEARS)

FIG. 2.

ceptable to cut street paving. Of this group, 934 or 53 percent of the total extensions during this period, were extended from stubs that were in the system for 15 years or more, some being as old as 39 years.

This adds up to a low percentage of extensions, not only during the first two to five years when paving should not be cut, but afterward as well.

Comparative Study Made

For the purpose of getting a clearer picture, we decided to analyze the two-year period of 1949-1950 and compare it with the 19-year period. These two years were chosen because the stub services installed during that time were done on a very selective basis. The city was then engaged in a large paving program in all sections of the city.

At the start, the city requested Public Service to make every effort to avoid cutting or making excavations in these newly-paved streets. A stub service program was initiated wherein every block to be paved was carefully surveyed and the prospects of stub requirements evaluated. Where feasible, property owners were contacted. Stubs were installed to all locations where it was expected that they would be extended within two to five years, depending on the type of paving.

During 1949 and 1950, a total of 571 stub services were installed. (See Fig. 2.) It was found that 23 percent of these were between one and two years of age when extended, and 21 percent were between three and five years of age when extended. Thus, 44 percent — or less than half — of the total installed were extended during the first five years. At the end of 1958, eight or nine years later, 229 stubs, or 40 percent of the total installed, still remain in the system waiting to be used, and 4 percent have been abandoned without being used. This record of extensions of stubs installed in this two year period is much better than the 19-year record. Yet, it is surprisingly low considering the special attention given to these installations.

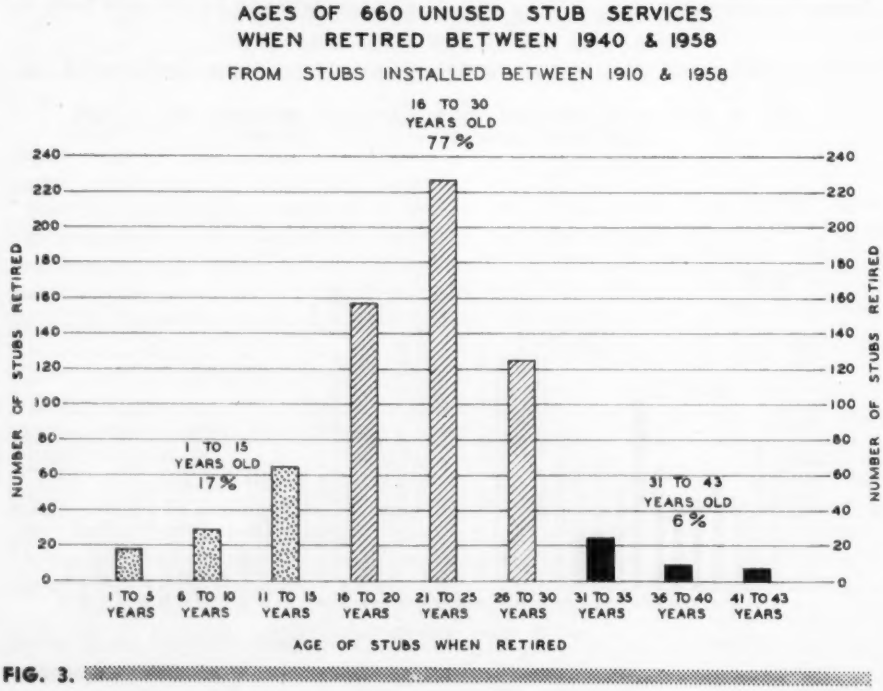


FIG. 3.

Stub Abandonments

During the period from 1940 through 1958, a total of 660 stub services were abandoned without being used. (See Fig. 3.) More than 80 percent of these were in the system 15 years or longer before being abandoned. Most of these stubs were abandoned in place with old cast iron main that was replaced with new steel main.

At the end of December 1958 there remained in the system a total of 1965 stub services still unextended. Well over half of these, 1635 or 83 percent to be exact, were installed prior to 1940 and are at least 19 years old.

These results clearly show that we greatly exceeded our needs in planning for stub services in the past. Less than half of the stub services remaining in the system at 1940, or installed since, were used.

Of those used, the majority were used long after a reasonable time span and could have been installed later as a standard full service installation at an overall saving and without causing ill feeling among residents or authorities. It is also clear that a certain number of stub services are necessary ahead of street paving.

If local regulations require stubbing, then the gas company has no choice. If there are no such regulations, then the gas company will have to use its best judgment based on what experience and information it can gather.

Acknowledgment

This article adapted from a presentation made at the 1960 A.G.A. Operating Section Distribution and Transmission Conference, New Orleans, Louisiana. ★ ★ ★

Service Records on Punched Cards

Philadelphia Gas Works taking big step forward in distribution operations by converting over 600,000 individual service records to punched cards; electronic data processing will speed handling operations, compilation of information for many needs

James M. Hefty, *Supervisor, Distribution Department*
Philadelphia Gas Works, Division of U.G.I., Philadelphia, Pennsylvania

OVER 600,000 "SERVICE RECORDS," representing more than 60 years of history of gas service in Philadelphia, are being given a "new look" by the distribution department of Philadelphia Gas Works.

Underway is a program to convert the data on the 3 x 5 cards to punched cards for use in an electronic data processing system. Since January 1959 a "task force" of seven PGW clerical employees under supervision of special assistant Harry Campbell has been working on a two-year program of transferring the data from existing records to "data sheets," from which IBM punch cards are then made.

The new electronic tabulating system, designed to speed handling operations of the distribution department's street service records and facilitate compilation of many special items of information, is another step in the 63-year history of the record system.

Since 1897, when United Gas Improvement Company took over operation of the city-owned gas works in Philadelphia, the PGW distribution department has maintained an accurate record of the size, length, location, depth, and other details about each service pipe and gas main supplying every customer's property.

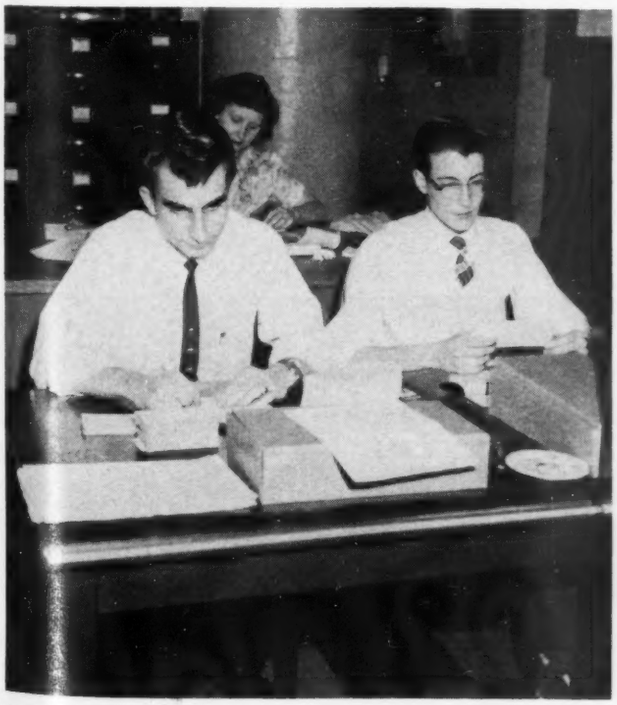
The street service record cards originate with the street foremen when a new line is installed or when an existing service is repaired, relocated, shortened, lengthened, or removed from service.

Over the years, the 3 x 5 card file has been modified and improved to record all this information and to include details about pipe coating, cocks, valves, cathodic protection, type of connection between main and service, and other features not originally included.

Records Have Many Uses

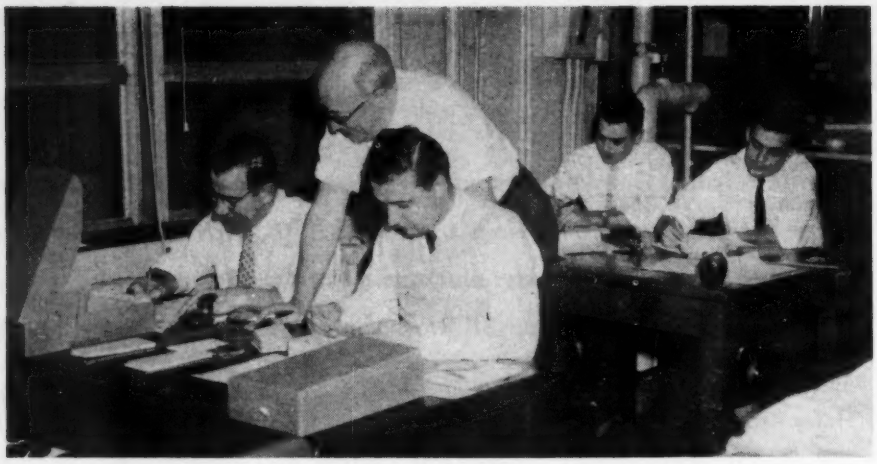
These accurate records have been a valuable aid. Their accuracy is such that PGW foremen, under both emergency conditions and in performing routine maintenance work, are able to locate underground structures with speed and at a minimum cost. As a result, many dollars are saved and potential emergency situations quickly remedied.

The need has long existed, however,



Conversion of street service records, now on 3 x 5 cards, to punched cards, has been underway since early 1959. Part of "task force" at work are Joe Ricciotti, left, and Dick Stalker. Busy in back ground: Gladys Rementer.

Street foreman Joe Dudley fills out service record on the job site. Cards originate with the street foreman. Project underway is a service renewal.



Revision of service records is being accomplished by a task force headed by special assistant Harry Campbell, standing. Transferring data from cards to intermediate "data sheets" prior to making punched cards are, left to right, Stanley Rishkofski, William Kuhn, Jr., Ray Brooks, and Robert Gallen.

for an economical, convenient means to summarize special information from all or a portion of the 600,000 record cards.

Specific examples of such information are the average life of a service pipe; the number of 60, 50 and 40 year-old services now in the system; the number and location of services with valves; and the number of high pressure services versus low pressure services.

This type of information is important not only in distribution operations, but also in formulation of management policies regarding service renewals.

Manual System Tedious, Costly

Under the present system which officially terminates in 1961, it is often time-consuming and costly to assemble needed information and it is difficult to keep the information up-to-date. Data has to be taken from each 3 x 5 card, listed, and then summarized.

Other important information is equally difficult to collate with manual clerical methods. Each day, for example, PGW's distribution department requires lists of services in designated areas for use by "leak" gangs and other crews assigned to main replacement work. Supervisors need data for various studies undertaken to improve our underground system.

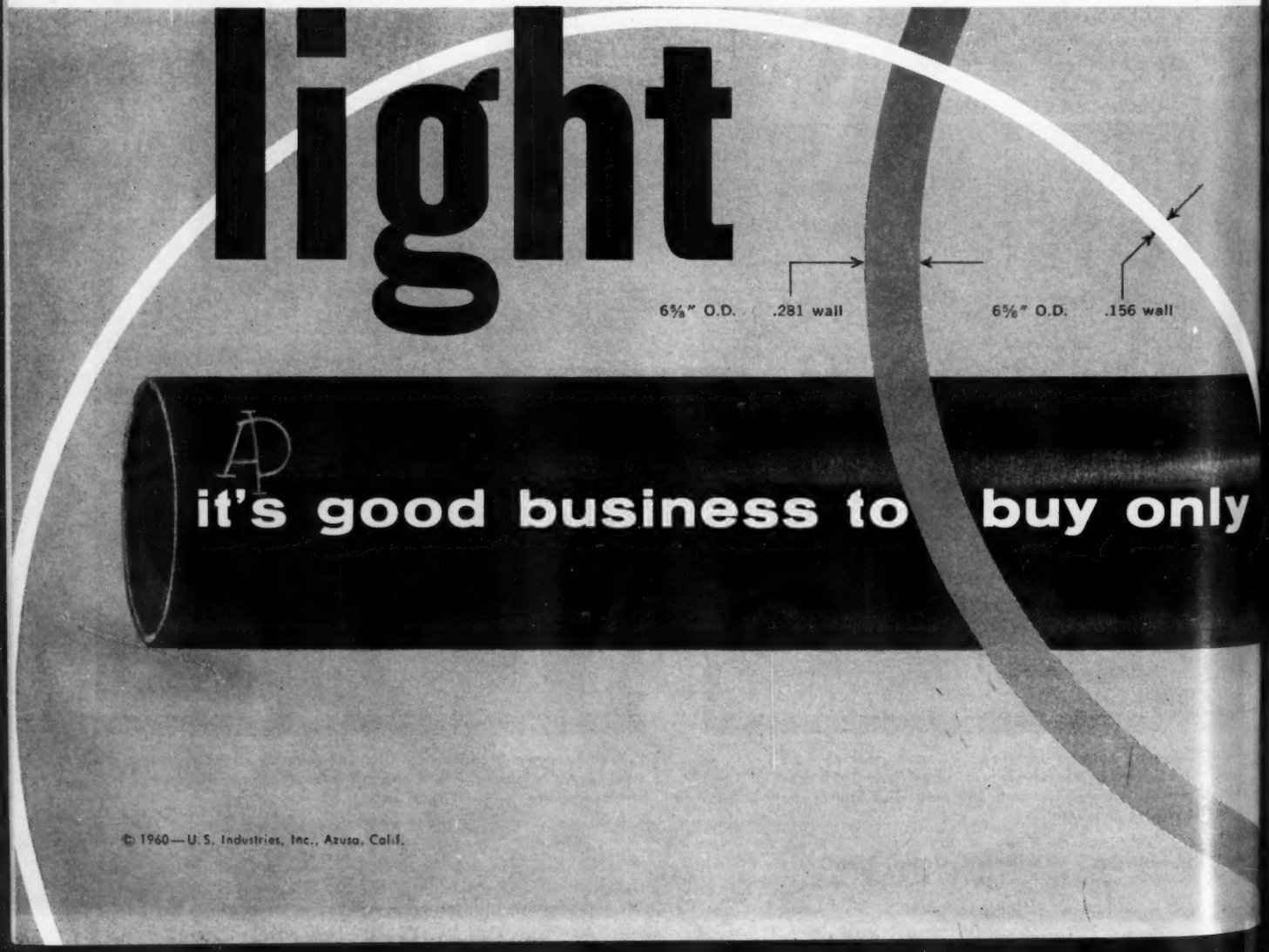
Foreign construction inspectors must be able to tell contractors installing sewer and water lines and conduits just where the gas structures are located. Engineering department estimators also consult the service records every day for information required in their work.

The present program of converting the 3 x 5 card data to punched cards for use in machine processing will greatly facilitate compilation of information needed by these numerous departments and operations.

Accuracy Verified

Before a card can be processed, it is essential to verify its accuracy. Numerous street visits are made to correct questionable addresses and to complete information required for the new record.

Some rather interesting observations have been made in preparing the records for the transition to punched card operation.



SERVICE RECORD

FORM 6059 5-58 ST.

NEW ☐
RENEWED ☐
OLD SIZE____
MAIN TO CURB ☐
CURB TO HOUSE ☐
MAIN TO HOUSE ☐
EXTENDED ☐
SHORTENED ☐
DISCONTINUED ☐
ABANDONED ☐
RECONNECTED ☐
ACCOUNT
_____

SIZE____IN. LENGTH____FT.____IN. WHAT IS BUILDING USED FOR?_____
SIZE____IN. LENGTH____FT.____IN. NATURE OF SOIL_____
LOCATION OF SERV.____FT.____IN.____OF____LINE GIVE SKETCH ON BACK FOR UNUSUAL CHANGES OF DIRECTION OR ELEVATION.
COCK ☐ LOCATION ____FT.____IN.____OF____CURB LINE
PLUG VALVE ☐ SIZE____IN. OF COCK
GATE VALVE ☐ OR VALVE: ____FT.____IN.____OF____HOUSE LINE
CAST IRON ☐ HIGH PRES. ☐
SIZE MAIN____IN. STEEL ☐ LOW PRES. ☐ DEPTH____FT.____IN.
LOCATION OF MAIN____FT.____IN.____OF____CURB LINE
SIZE TAP AT MAIN____IN.
BONDED YES ☐ NO ☐ COATED YES ☐ NO ☐
KIND OF CONN. JOINING SERV. TO MAIN: SERV. TEE & SERV. ELL ☐ WELDED NIPPLE ☐ COCK ☐ _____ ☐
ISSUED BY_____DATE_____REASON_____
FINISHED BY_____DATE_____

Service record being replaced is this 3 x 5 card.

One is the unbelievable accuracy and fine penmanship of PGW foremen who originated records as far back as 1900.

It was customary in those days to list the names of customers as part of the record, and PGW personnel occasionally reminisce when the names of former Philadelphia Mayors and other leading citizens appear.

By examining the old records, PGW has been able to reconstruct the expansion of some of the city's largest industries. Occasionally, a record that originated in the early 1900's is listed as a "carriage house" or "stable." Today, the same buildings house garages or machine shops.

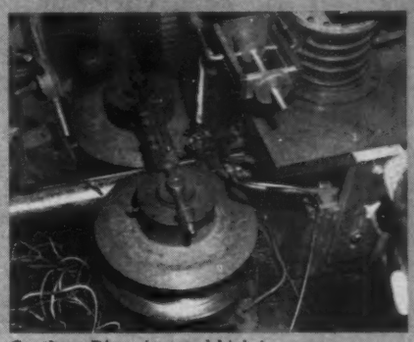
How Data Is Transferred

The data form contains 80 columns in which particular types of information can be listed. Each form contains

specify LITE-WALL save as much as 33%

Approximately $365,000 in pipeline cost was saved by specifying and buying Southern Pipe LITE-WALL pipe. (Company name on request.) The job called for a 147-mile, 6⅝" petroleum products line. LITE-WALL pipe cut cost by more than ⅓.

It's good business to buy only the steel necessary to do the job. In many cases you needn't buy heavy wall pipe, when Southern's LITE-WALL pipe—available from factory stock—will meet your requirements and afford an ample safety factor.



Southern Pipe pioneered high frequency resistance welding in pipe production.

Southern Pipe offers oil and gas pipe buyers LITE-WALL pipe to cut cost. They also produce line pipe according to API specifications. Sizes range from 3" to 14". Interior and exterior coatings are also available.

Write for SOUTHERN PIPE'S LITE-WALL PACKAGED PIPELINE brochure today.

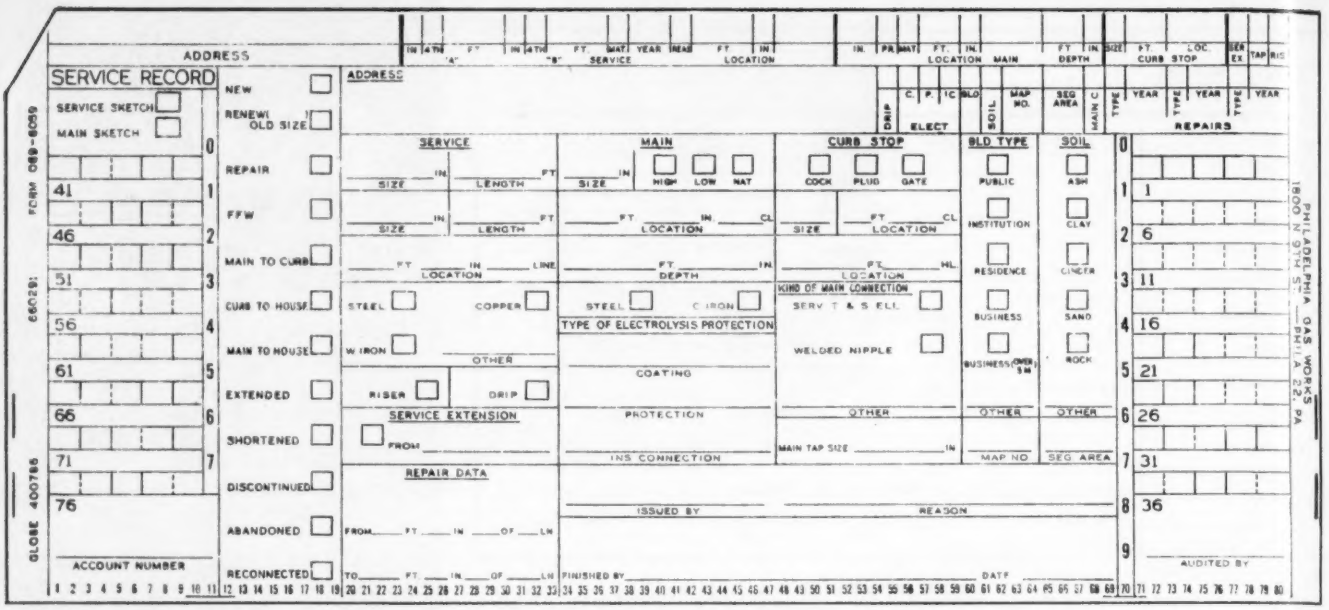
ly the steel necessary to do the job—

USI

Southern Pipe

DIVISION OF U. S. INDUSTRIES, INC.
P. O. Box C, Azusa, California • CU 3-7111 • ED 7-1221
P. O. Box 1323, Honolulu, Hawaii • Phone 28-5757

SP-6-60



New form for service record is familiar punched card.

space for 29 individual locations. Presently, about 200 forms representing 6000 addresses are sent to machine accounting each week for key punching.

In the first step of this operation, a key punch operator punches out the information from the data form to an individual IBM service record. When completed, the card contains numerous punches but shows no printed information.

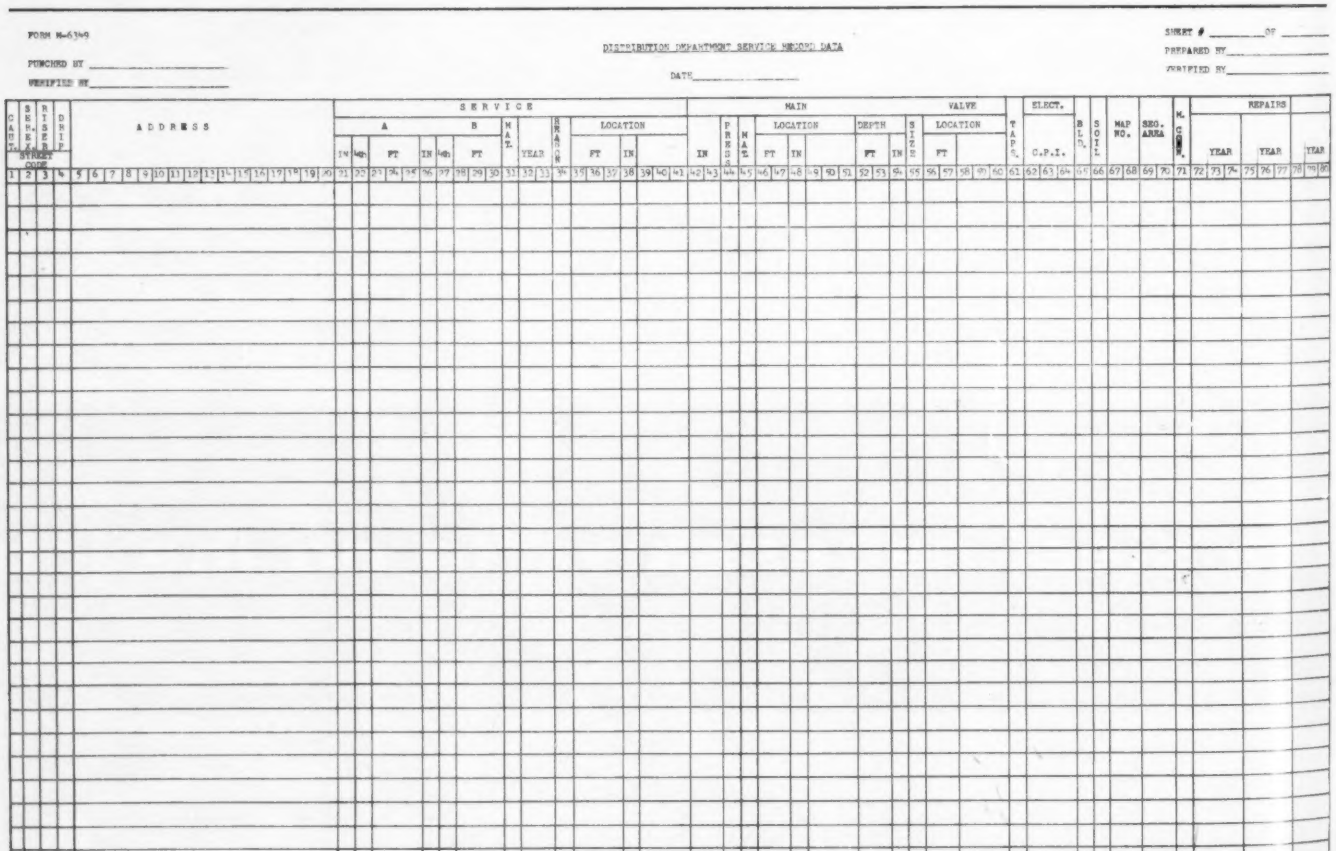
The punched cards are then inserted in a second machine that automatically interprets and prints the information indicated by the punches. In this operation, the cards are fed automatically into the machine and processed with amazing speed.

A sorting machine does the final operation in machine processing. Cards are sorted alphabetically at the rate of 1000 per minute.

Distribution personnel are looking forward to the completion of this program in January 1961. Benefits derived from this modern record system will more than justify the effort expended in its successful completion.

PGW is firmly convinced that the time and effort expended in the transition to exact and complete IBM records will reward it amply in the years ahead.

* * *



Information on present cards is transferred to this data form. This form goes to key punch operator who makes initial punched card.

AQUIFERS for Underground Natural Gas Storage

3 | Lease rights; drilling; well spacing; logging; service facilities

Joseph A. Kornfeld, *Natural Gas Consultant, Tulsa, Oklahoma*

Lease Rights Acquisition

Prior to commencement of actual exploratory drilling of the aquifer structure, steps must be taken by the gas company to acquire valid lease and rental rights to the use of both surface and subsurface rights.

Surface rights. Where surface rights and mineral rights are owned separately, it is necessary for the gas company to negotiate with and prepare a contract with the surface owner to provide for the following conditions:

1. Right of ingress and egress.
2. Right to conduct surface operations including the drilling and completion of water wells, gas injection wells, and observation wells.
3. Right to install necessary surface equipment on the premises such as wellhead equipment, meter runs, dehydration stations, and compressor stations.
4. Provision for compensation of surface owner for any damages to premises or loss of property due to subject operations.
5. Payment of location fee for use of land for drilling operations.
6. Payment of annual rental prior to actual drilling operations, i.e., $1 per acre per year.

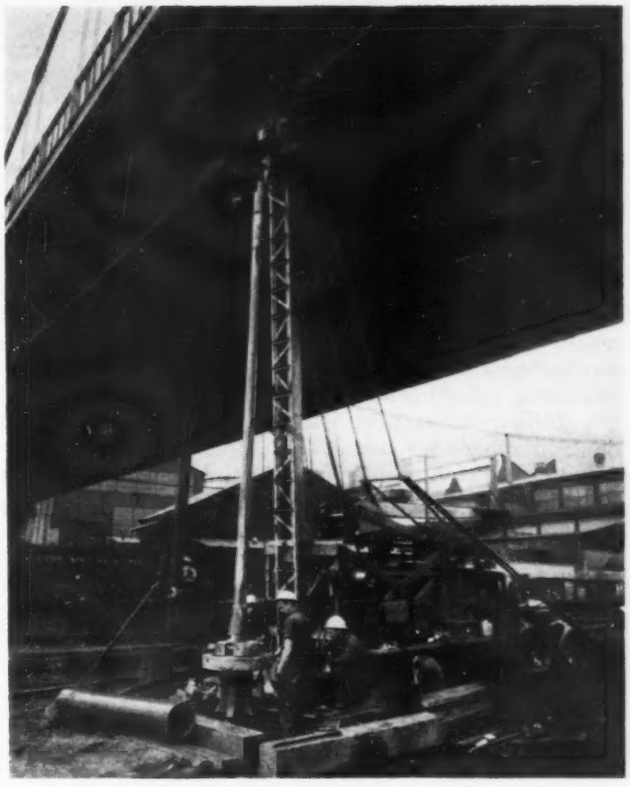
Subsurface rights. Where the mineral rights are owned separately, the gas company may elect to purchase the mineral rights in fee.

If, however, valuable mineral deposits exist in the area under survey, which would make impracticable the purchase of the mineral rights, a storage lease can be prepared between the gas company and the mineral rights owner to cover the gas storage rights lying in a particular sandstone lying at a specified depth below the surface.

The Drilling Contract

Gas companies planning development of an aquifer enter into an engineering contract with a water well supply contractor. As adapted to aquifer exploration and development for gas storage applications, the engineering contract will cover both *pilot gas injection,* and *full development provisions.*

The water well contractor will work closely with consulting engineers which may be selected by the gas company to design underground casing, metering and other types of instrumentation, deep well pumping equipment, gas injection and gas withdrawal wellhead equipment, and the like.



Cable Tool Rig employed in water-well drilling for aquifers to be utilized for underground natural gas storage. Mounted on the end of the kelly joint is a rock reamer; bailer is shown on the ground at left.

Well Spacing

Engineering principles involved in spacing of water wells for underground storage of natural gas in aquifers are divided into two major categories:

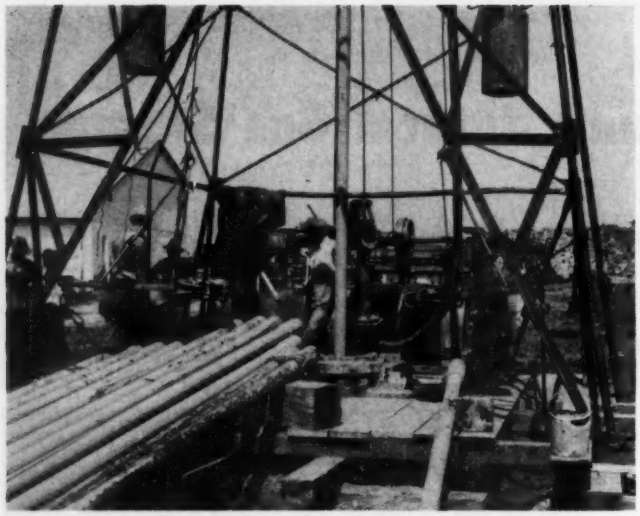
1. Hydraulic principles that account for *minimum drawdown* of the aquifer and for *optimum discharge.*
2. Gas movement control: Optimum spacing for the crest of the anticline or dome to permit maximum *injection* and maximum *withdrawal* per unit of time of gas from the aquifer. The time factor is more significant for maximum withdrawal rates in order to obtain important volumes of natural gas on short notice for peak-day winter requirements.

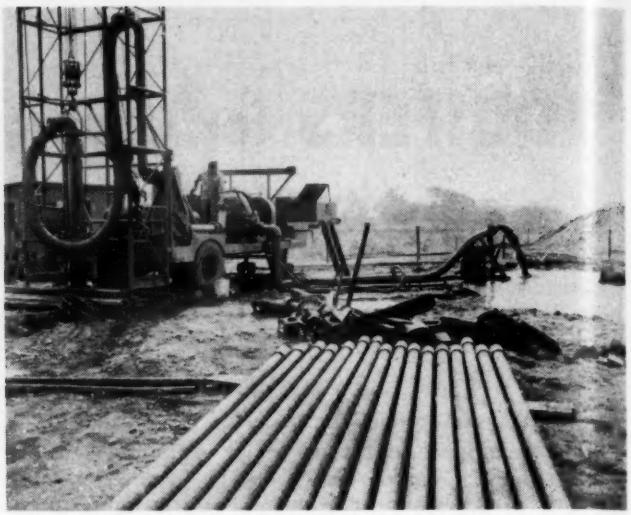
EDITOR'S NOTE: This installment is the third in a series of four engineering articles on the subject of "Underground Natural Gas Storage in Aquifers" being presented each month as part of AGJ's continuing educational-refresher series on natural gas and gas distribution operations.

The first installment *(April 1960)* analyzed the need for gas storage, types of storage, and history of aquifers. The second installment *(May 1960)* covered criteria for selection of aquifers, geology, lithology, and economics.

This installment covers lease rights acquisition, the drilling contract, well spacing, drilling, logging and completion of input, output, and service facility wells.

The fourth installment, to be published in the July 1960 issue, will cover performance data of aquifer-type natural gas storage reservoirs, analysis of performance data covering various types of stimulation of individual water wells, and the use of tracers in remedial operations.





Rotary Rig Types employed in drilling water wells for natural gas storage in aquifers. At left is a straight rotary-type rig, drilling a rotary hole through a sequence of sand, gravel, and clay; in the foreground is a 4½-in. drill pipe. At right is a typical trailer-mounted, reverse-circulation rotary drilling rig, showing arrangement for circulating drilling fluid up through drill pipe.

(Photos courtesy Oliver C. Lewis.)

The Pilot Well

Following core drilling and exploratory geophysics, the contractor is ready to proceed with drilling of the pilot permanent well, which will be used for injection experiments and for initial tests of the aquifer reservoir. It is usually desirable to drill the entire series of possible aquifers in order to select the best aquifer for underground natural-gas storage, unless a satisfactory aquifer with sufficient reservoir volume is found at an economic shallow depth.

In the case of the initial pilot well drilled on the Florissant structure north of St. Louis, Missouri, exploratory drilling continued to basement rocks at a total depth of 3240 ft, penetrating the entire sedimentary sequence, despite the fact that the St. Peter sandstone aquifer of Ordovician age was found at the shallow depth of 1450 ft with high permeability and specific yield.

Diamond coring utility. As the principal aquifer objective is approached, it is desirable to change drilling bits and to run a diamond-core head and core-barrel to core the cap rock, the aquifer, and the possible sealing beds that may lie beneath the aquifer.

The utility value of diamond-coring of water wells in aquifers for natural-gas storage lies in:

1. Determination of the permeability of the aquifer, through subsequent laboratory analyses of the rock;
2. Determination of whether or not the cap rock will be sufficiently impermeable to prevent leakage of gas and/or fluids after commencement of storage operations; and
3. Determination of the impervious character of rocks lying immediately beneath the subject aquifer into which gas will be injected and withdrawn.

Drilling Equipment Types

Water well drilling procedures are divided into (a) cable-tool drilling and (b) rotary drilling, and modifications of both major types.

Cable-tool drilling. The standard or cable-tool method, which was developed in drilling for oil production, is similar to the familiar method long employed for the drilling of shallow water wells. This method enjoys a specific advantage over the rotary method where thick sequences of hard rock layers — such as chert — are encountered.

Essentially, the string of cable tools consists of a steel bit, an auger-stem into which the bit is screwed, and a pair of "jars" that join the auger-stem to a sinker-bar. The equipment is mounted on a rope cable that passes over a pulley-wheel mounted in the top of the derrick and then down to a winding drum.

Just above the drum, the cable is attached by means of a "temper" or adjusting screw to a large walking-beam operated by a steam or internal combustion engine. The drill is lowered by the "temper" screw as the work progresses. As drilling operations proceed, the casing is carried and finally lowered after underreaming to the desired depth on top of, or through the aquifer.

Rotary drilling. This type of drilling operation is divided into (a) conventional rotary drilling, (b) reverse circulation rotary drilling, and (c) air rotary drilling.

With the introduction of the rotary drilling rig into the oil fields of the United States about 1894 at Corsicana, Texas, advances came fast in penetration techniques, equipment, and drilling bits. Today, the truck-mounted conventional rotary or reverse-rotary rig has found major popularity in most of the geographic areas of the nation for development of deep well aquifers.

An inherent advantage of the rotary drilling method is to overcome drilling problems occasioned by the occurrence of very heavy boulders and gravels and high static water levels.

Conventional rotary. In conventional rotary drilling, the lower end of the drill pipe, usually 3-in. in diameter, is provided with a drilling bit of a diameter from 4 to 4½-in. The upper end of the drill pipe is connected by a swivel to a water pipe through which "rotary mud" is forced by suitable mud pumps. The well is drilled by rotating the drill pipe by means of a rotary table that is chain-driven by a geared drawworks, which, in turn, is powered by an internal combustion engine. This engine also powers the mud pump.

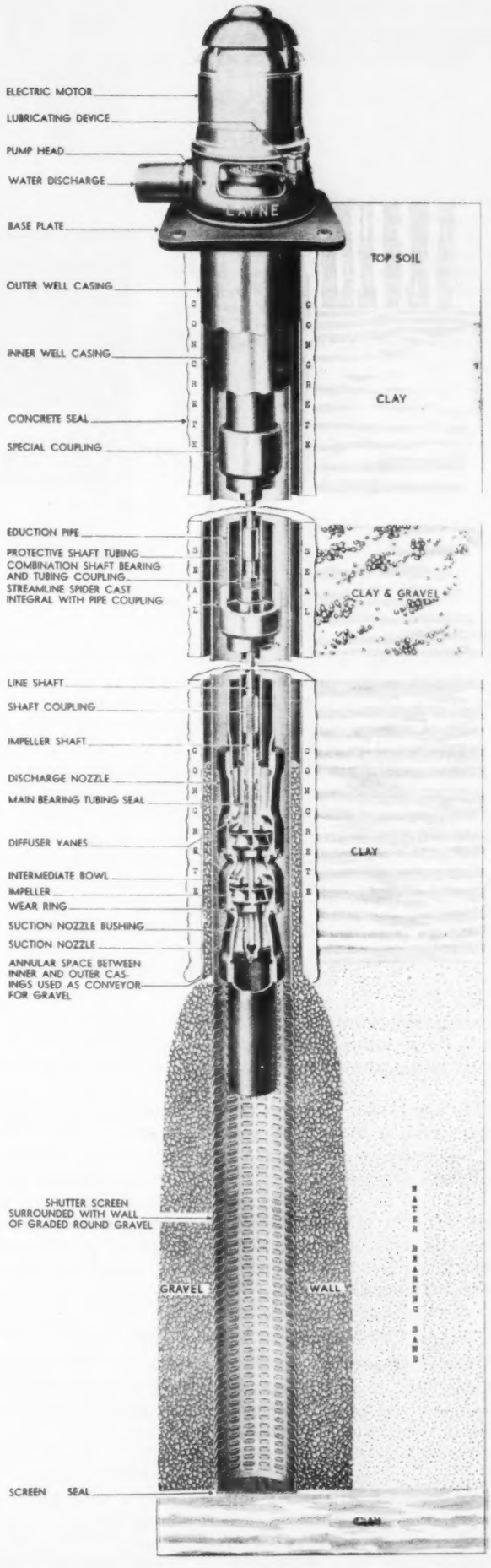
Rock fragments cut by the bit are floated to the surface by the drilling mud, which circulates down inside the drill pipe and up the outside through the annulus space between the drill pipe and the rock walls. A mud-cake or layer about 3/32-in. thick is built up to protect the walls of the well from caving.

A record is kept daily of the following set of facts:

1. The top and base of each stratum penetrated;
2. Drilling rates, minutes per foot;
3. Drilling mud losses;
4. Static fillup levels of each aquifer source;
5. Samples of water encountered in each aquifer;
6. Mud weight, expressed in lb per gal;
7. Viscosity, expressed in API seconds marsh funnel; and
8. Additives to mud, type and amount of each.

Typical Cross Section of a gravel wall well and vertical turbine pump installation, showing casing and cementing arrangement, gravel-wall packing, screen setting and exposed details of bottom-hole equipment.

(Courtesy of Layne-New York Co., Camden, N. J.)



Reverse-circulation rotary. McEllhiney has analyzed the advantages of the reverse-circulation rotary method of drilling wells in aquifers over the conventional drilling methods as follows:

1. Lower cost per foot;
2. Wells can be drilled with larger bores;
3. Wells can be drilled with comparative ease into deeper sands and gravel;
4. Result of better clean-cut surfaces on the well bore, especially in laminated formations; and
5. Test pumping is the only requirement needed to evaluate the individual aquifer penetrated by drilling.

He states, however, that the following conditions must be fulfilled before reverse-circulation rotary drilling can be undertaken at a given well-site:

1. Accurate geological data from nearby wells must be made available for the drillers;
2. An ample water supply must be available nearby for drilling purposes;
3. An adequate supply of clay must be available on short notice for immediate use;
4. Availability of proper size and length of well casing to be installed immediately on completion of drilling operations;
5. Selection of a setting screen of correct size and fittings available at the drill site before commencement of actual drilling.
6. Availability of gravel-packing ingredients of the proper grade in sufficient quantity.
7. Continuous drilling, around the clock.

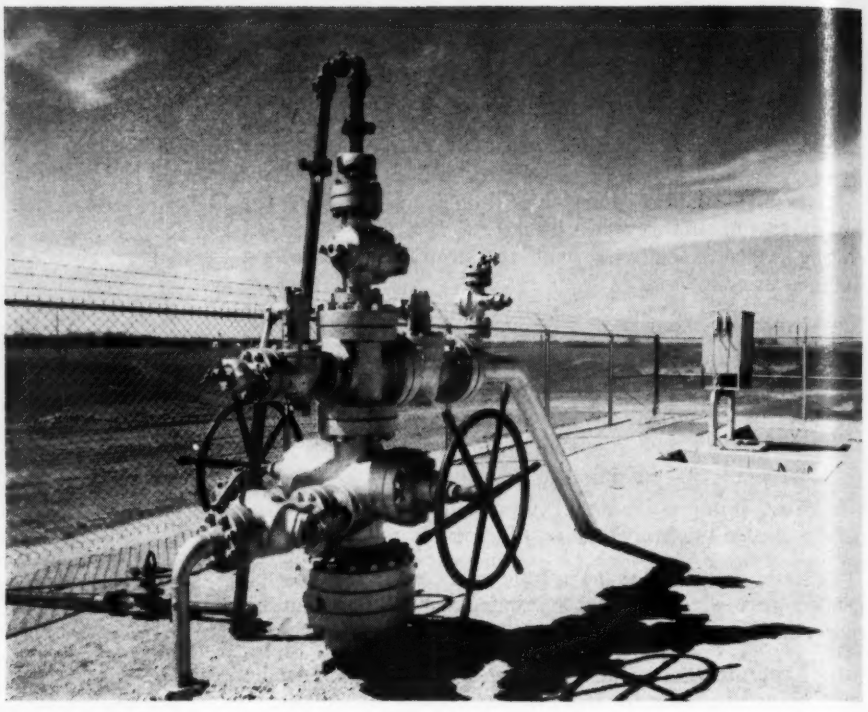
Electric Logging

Dobrin explains that electrical prospecting makes use of three fundamental properties of rocks:

1. Electrochemical activity with respect to electrolytes in the ground, which forms the basis for the *spontaneous-potential* methods, which employ a single electrode opposite the sand-face.
2. Resistivity, or inverse conductivity, which governs the amount of current that passes through the rock when a specified *potential difference* is applied.
3. *Dielectric constant* gives information of the capacity of a rock material to store electric charges; these must be taken into consideration when high-frequency alternating currents are introduced into the earth, as they are with inductive prospecting techniques.

The electric log provides an accurate record of the formations penetrated by the drill, as it reveals changes in the *depth*, *character* and *thickness* of each formation encountered.

In addition, the utility of the electric log also lies in its value as a guide for future expansion of the aquifer, completion techniques, and remedial operations, not only for input and withdrawal but also for observation wells as well. It is a valuable correlation tool to accurately map the subsurface structure of the aquifer. By means of electric log cross-sections, the reservoir volume of the aquifer can be accurately calculated, which forms a basic need for determination of the gas capacity of the aquifer.



Typical wellhead installation in the Florissant aquifer natural gas storage field north of St. Louis, Missouri. This installation is equipped for injection and withdrawal service. A cross-over line at the manifold permits metering of the gas on either injection or withdrawal. Blowout-preventer is standard equipment.
(Photo courtesy Laclede Gas Company.)

Completion

Underreaming. After the bore-hole is drilled through the desired aquifer, the diameter of the aquifer zone is underreamed to a diameter of from 24 to 32-in., depending upon the size of the outside casing and the amount of water to be developed. This is brought about by the running of an underreamer which is expanded when set opposite the water sand. This enables the contractor to place a gravel filter uniformly around the well screen by hydraulic means.

This provides a greatly increased annular space around the screen which enables placing of a thick blanket of selected gravel around the entire length of the screen. The gravel blanket is prepared so as to be uniform in wall thickness throughout the setting, thus retaining the original position of the native aquifer sands. When properly designed, the gravel wall permits the maximum quantity of water to enter the screen.

Casing Requirements. The aquifer production casing should be of sufficient diameter to accommodate the permanent pump which will be installed later in the completed well.

(The completion casing is differentiated from conductor casing which is set at very shallow depths to protect the well from cave-ins due to unconsolidated sands or gravels.)

After the completion casing is set, a special expanding drill bit, called an *underreamer,* is employed to drill the aquifer reservoir out to large diameter. The actual diameter of the screen and underreamed section is determined usually after a pilot or test bore hole is drilled and the waterbearing formation is analyzed carefully.

(Typical gravel-wall well and completion arrangement for setting a vertical pump is shown on page 37.)

Gravel-wall packing. In those cases where the aquifer contains little or no gravel, it is very advantageous to *gravel-pack the well* by inserting a layer of fine gravel between the wall of the bore-hole and the well-screen. When a water well is drilled with the rotary drilling process, the completion casing — together with the desired screen — may be set after drilling is completed and a large amount of gravel placed by dumping into the annular space between the casing-screen setting and the face of the well-bore opposite the depth of the aquifer reservoir. However, under these conditions, the mud-cake originating from the drilling fluid must be thoroughly washed out by rapid pumping of the well on completion.

The size of the gravel is chosen following examination of the size distribution of the water-bearing aquifer sandstone. Moreover, the size of the gravel employed together with the size of the well-screen opening accomplish the purposes of permitting the water to enter the intake area of the well under the following optimum conditions:

1. Lowest possible fluid velocity;
2. Greatest possible reduction of sand-carrying capacity; and
3. Lowest amount of friction loss.

Screen selection factors. Hydraulic principles employed in selection of the complete screen have been mentioned above. The first step involved is recovery of a clean sample of the aquifer sandstone from which laboratory tests are conducted to determine the range of distribution of grain sizes.

For use with gravel packing between the screen and sand, the shutter screen is used; the openings are made large with overhanging lips and are especially useful where the water-bearing material contains little or no course material. Because the water is forced to pass through a very small cross-sectional area, the resistance to entrance will be comparatively great immediately adjacent to the slots.

Where coarse material is found to be present together with the fine sizes, a string of perforated pipe or a coarse screen is used to good advantage.

Following completion of gravel-packing and screen-setting operations, the well is equipped with a vertical turbine pump and tested at maximum operating capacity that may range from 250 to 750 gal per min.

Gas service wells are equipped with a combination wellhead or Christmas-tree assembly that will permit either injection or withdrawal service. A typical wellhead installation in the Florissant aquifer gas-storage field near St. Louis, Missouri is shown in the accompanying photograph.

Each wellhead is equipped with hand-operated valves and an orifice meter run and recording meter. There is a cross-over line at the manifold so that gas can be metered on either *injection* or *withdrawal.*

How To Evaluate Jobs

Robley D. Stevens, *Management Consultant, Washington, D. C.*

PROMOTING the will to work, meeting pay demands, and determining what constitutes a fair and equitable wage rate for a given job continues to be a perplexing problem to some employers in the gas industry. In any field, sound management-employee relations are essential to economical and efficient operation.

Dissatisfaction over pay rates can do much to impair employee efficiency, lower morale, and increase personnel turnover. Management should ask itself the following questions:

How does our company set pay rates?

How do we solve pay problems?

Are there any inequities in pay among employees on the same job?

How do our rates compare with other employers in the gas utility industry?

To obtain true and objective answers to such questions there is no substitute for setting-up and maintaining an effective job-evaluation plan based on a thorough analysis of every job in your company.

Basic Principles

Most authorities in personnel management agree upon certain basic principles in the operation of a job-evaluation plan.

First, it must be easy to understand, simple and efficient to operate, and flexible in its application.

Second, compensation paid to workers should be based on the comparative worth of different jobs.

Third, it must inform management on the effectiveness of productivity.

The task of devising a job-evaluation plan is one of deciding on your company's specific needs and the extent to which it is reasonable to add detailed procedures to a basic plan in order to provide for those needs. Any job-evaluation plan should be so set-up that changing needs may be met with the least possible disturbance and cost to the company and its personnel.

Analyzing the Job

Analysis tells who does what. It is the determination of the tasks, skills, knowledge, and responsibilities required of the employee for the successful performance of the job. It also reveals the use of skills on the job.

To be useful for job-evaluation, an analysis should give a detailed breakdown of all the factors involved. Such an analysis also should provide an organized picture of the abilities significant to job competence.

Collection of data in a systematic way and orderly manner not only reduces the required effort but also is helpful in insuring adequate coverage and weighing of all aspects of the company jobs.

Analysis can be used to determine the specific qualities required of employees to fill jobs for recruitment and placement purposes. Employees cannot be trained adequately unless the nature, duties, responsibilities, and other significant factors of their jobs are known and understood.

There are three parts to the analysis of a job:

1. **Job must be completely and accurately identified;**
2. **Tasks of the job must be completely and accurately described; and**
3. **Requirements the job makes upon the employee for successful performance must be indicated.**

First step in the analysis of jobs is an exact determination of what are your company jobs and their precise limits — meaning where the jobs end and where they begin.

Contrary to popular belief, it is not necessary to engage outside counsel to install such a system. All that is really essential is reasonable intelligence, objectivity, and a willingness to do the work.

In fact, a personnel executive can collect complete, accurate, and intelligible job descriptions from the employees. Each employee can do this part merely by filling out a questionnaire prepared for this purpose. Such participation can help sell job-evaluation to your employees.

In making a job analysis, the personnel executive or the supervisor should interview the less-efficient as well as the more-efficient workers. Both can help provide a complete picture of typical duties and kinds of knowledge and skills needed to perform the duties adequately. In fact, critical areas of knowledge may be pinpointed in this manner.

Job Contents

It is usual for a job analysis to cover the following information:

1. **Job title** — name by which the job is commonly called.
2. **Alternate title** — any title other than the one commonly used.
3. **Number employed** — number of employees on job at time of analysis.
4. **Work performed** — a thorough and complete description of the duties.
5. **Experience** — any that an employee must have before he can do job.
6. **Date** — on which job analysis was made.

7. **General comments** — all other factors pertinent to the job.

The term "job" is often used in many different ways and has different meanings according to the company using the terms. To some it means a specific *task;* to others it means a group of tasks — *a position;* to still others, it means a group of similar positions — *a job.*

A **task** is created whenever human effort must be exerted for a specific purpose. When enough tasks are accumulated in your company to justify an employee, a **position** is created.

A **job,** however, may also be defined as a **group of positions** which are identical with respect to their major or significant tasks. Thus, a job may be considered as a group of positions which are sufficiently alike to justify their being covered by a single analysis.

In analyzing a job, the objective is to be able to describe it in specific and common terms. The main ones are the **kind of work performed,** the **skills needed,** the **responsibility required,** the **effort called for,** and the **working conditions involved.**

In plain, everyday language, writing up a job-sheet is valuable in making certain that the elements of the job are clearly identified. It gives management a road-map with which to proceed to the *classification* and *pricing* of the job.

What does the employee do? What is he actually expected to accomplish? Is he being asked for too little?

Once this information has been established, the next step is to choose one of the following **four basic job-evaluation plans** now in general use.

Job Evaluation

The personnel executive and the supervisor should know and understand that the first scientific study of jobs and wage relationships was advanced in this country in 1881 by Frederick W. Taylor, who made time-studies and analyzed jobs into units. The analysis consisted of a sequential listing of the steps required for productivity and the time necessary for each step. Out of this approach arose the many wage compensation plans which we find in evidence today.

Your gas utility company will favor use and installation of an effective job-evaluation plan because it assures management of a relatively stable unit personnel cost and incentive toward greater employee efficiency. It seems unfair to pay the same wages to a slow worker as to a more efficient one.

In determining how much an employee should be paid, your company should take into consideration the following factors:

1. The employee's responsibilities and the qualifications essential to perform his work assignment,
2. His actual performance, and,
3. The job value from an analysis.

Job-evaluation, therefore, is a management tool to determine these things.

1. Ranking system. This method is often referred to as the card-sorting system because the jobs in your company are arranged from high to low, as in a deck of cards. All the jobs in your organization are ranked in order of their importance, in relation to other jobs, without reference to money or to the individual employee holding down the job. A good method is to list the jobs horizontally and have the personnel executive rearrange them vertically in order of their importance. The vertical lists from the different departments are then combined into one organizational chart. With this plan it is necessary to check to avoid disagreement.

2. Job classification system. In this system, a number of categories or grades are established in advance and all the jobs in your company are then assigned to these classifications. Such a method presupposes that every job in your organization contain definite elements or phases that can be classified into grades. The grades are then established on the basis of difficulty and responsibility as represented by the number and kinds of management rules regulating the work being done and by whether or not and how often the work is subject to checking. Success of such a job-measuring stick depends on a thorough knowledge of all the jobs in your company so that every work element can be taken into consideration and the duties and responsibilities of every employee can be clearly distinguished.

3. Factor comparison system. There are several differences between this method and the point-system. One difference is that in the factor-comparison method the graded factors are assumed to be fundamental to all jobs in your company. Another difference is that in this plan jobs are evaluated relatively, with existing jobs in your organization used as points or degrees on the evaluation scale, whereas, in the point-system descriptive job definitions are used. This method also has the advantages of simplicity and of establishing a fixed relationship between job value and actual compensation, since it is based on key jobs for which compensation is standard in your company or, at least, not subject to any controversy. Once the key jobs in your organization have been selected, they should be ranked from highest to lowest in order of their importance. After the ranking, however, the key jobs are evaluated from study and examination of individual job descriptions. All other jobs in your company are then related to the key jobs.

4. Point system. This method is probably the most widely used today, and it seems to be gaining still greater acceptance. Briefly, it works something like this — a number of predetermined factors, such as — age, education, years of training, experience needed, and physical effort involved — are found common to all jobs in your company.

A schedule of points is then set-up for the various graduations of each factor. The levels, or grades, in each factor should be expressed or defined in writing, and it is also desirable to have each definition accompanied by examples of standard, well-defined jobs in your company. These standard jobs should be based on the abilities an employee brings to the job, the extent to which he is called upon to use these abilities, the responsibilities the job demands, and the conditions under which the individual jobs have been evaluated, then the sum of the job factors should be well under the maximum total points of the system.

Pricing the Job

This is the last phase of job-evaluation. It is a procedure by which a dollar rate of compensation is adopted for the jobs in your company which have been previously analyzed. Of course, the pay for the various jobs should conform to the values of those jobs as established by analysis within your company, and, the resulting pay plan should fit the going wage scale of a skilled worker in the labor market in which your company competes.

After the jobs in your company have been evaluated or related in terms of difficulty and value by one of the four systems outlined, your company will make this data of value for compensation purposes.

Job analysis you know, is a process of studying the operations, duties, and organizational relationships of the jobs in your company to obtain data for writing job descriptions and specifications. **Job-evaluation,** however, is a complete operation of determining the value of an individual job in your company in relation to the other jobs.

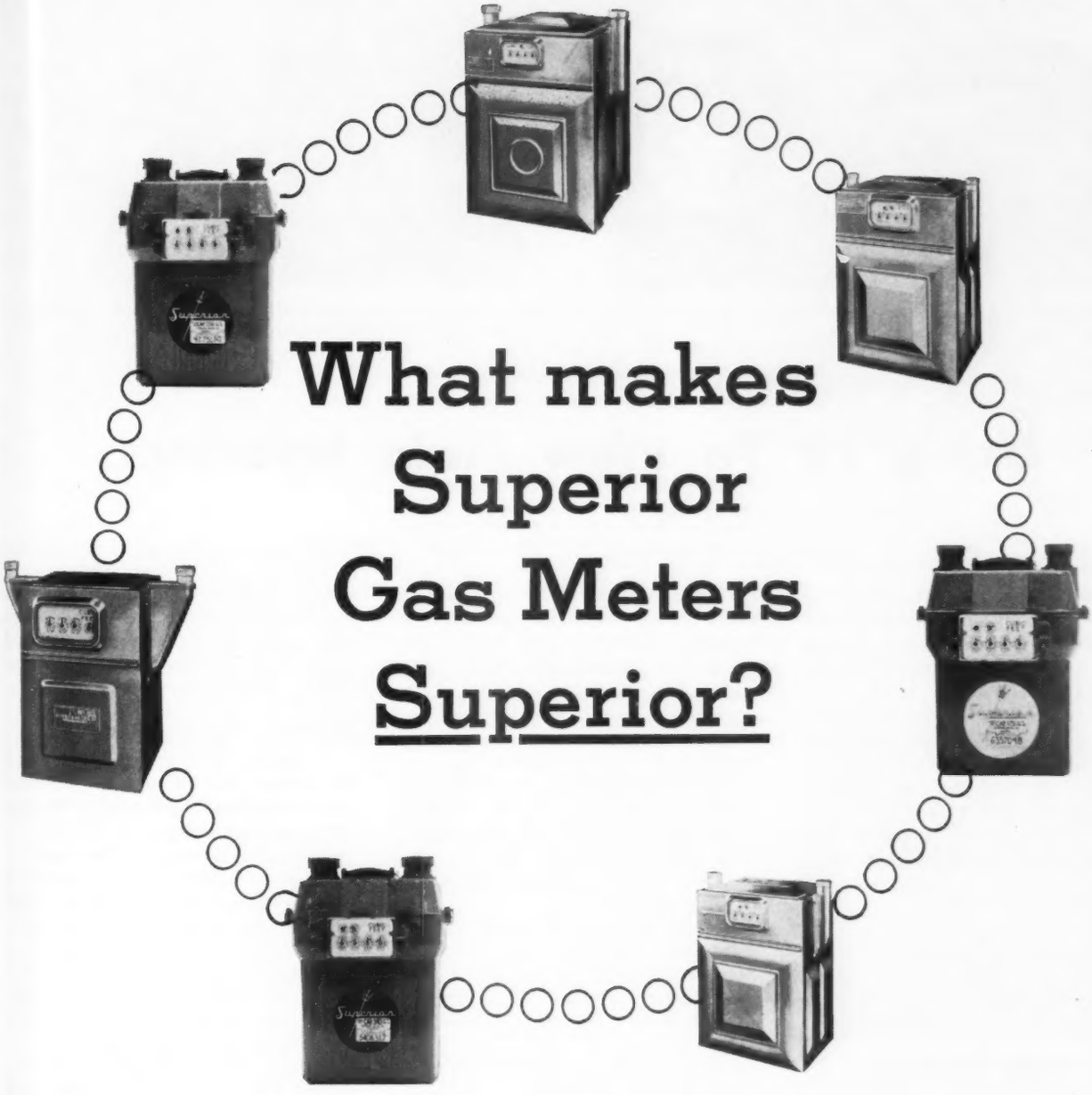
You'll Profit by Reading . . .

If your company is interested in exploring the subject further, you may want to consult the following books for use and reference:

Job Evaluation, McGraw-Hill Company, New York 36;

Job Evaluation, John Wiley & Sons, Inc., New York 10; and

Applied Job Evaluation, The Ronald Press Company, New York 10. * *



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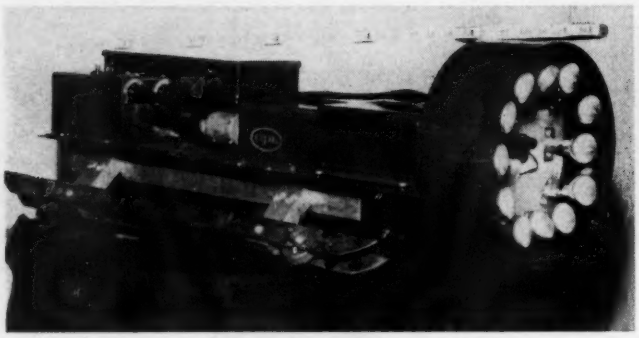


Fig. 1. TV camera assembly is approximately 3-ft long. Twelve 20-w spotlights provide illumination for camera.

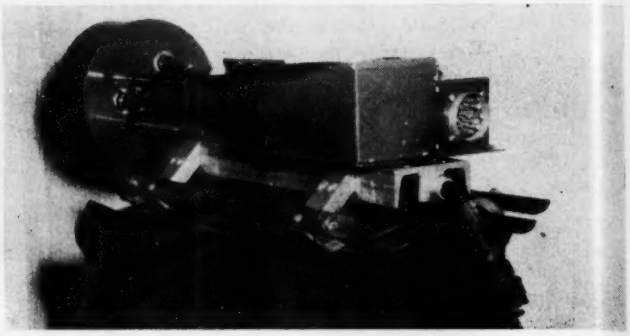


Fig. 2. Rear view of camera assembly shows carriage details, 24-wire conductor connection, and push-rod "snap-on" connection.

In New York, Consolidated Edison is . . .

Using TV To View Main Interiors

C. P. Xenis, *Engineering Department*
Consolidated Edison Company of New York, New York City, New York

TELEVISION is not a tool that a gas distribution company would use every day. But it does have application in helping solve several difficult problems. It can be used, for example, to:

1. Locate unmapped connections;
2. Inspect pipe for corrosion holes;
3. Examine joints in CI mains;
4. Examine valves to determine if they are open or closed;
5. Determine if water in main;
6. Locate obstructions in the pipe;
7. Inspect sealing operations on cast iron mains.

Use of television to perform such jobs requires one thing specifically — an open main. This is necessary for introducing the equipment into the main to carry out your internal inspection.

TV for Mains Developed

As part of an extensive program that resulted in the development of methods for sealing leaking joints in cast iron mains by internal sealing methods,* it became evident that some method was needed for internal inspection of the condition of the mains. Likewise, it was necessary to locate joints, obstructions, breaks, points of entrance of water, and to inspect the work performed.

This was particularly essential in the small size mains — 12 to 24-in.— where personnel could not enter to perform such inspections. The use of a television camera seemed to be a natural for this work.

Several small-size television cameras were demonstrated to Con Ed personnel. All of them had merit, but required a considerable amount of development to adapt them to the company's needs.

*Article discussing Con Ed's experiences with the Fuelling method of internal sealing appeared in *American Gas Journal*, August 1958, page 22. For further references on internal sealing, see *AGJ*, December 1958, page 17; *AGJ*, May 1959, page 39; and *AGJ*, June 1959, page 18.

One of the more promising cameras was made by a firm in Con Ed's territory and Con Ed engineers worked closely with this firm in developing the various items required.

Carriage and Lighting

A special carriage for transporting the camera into the pipe was designed and constructed by Con Ed. Producing a practical device of this type involved several problems. The manufacturer, in turn, altered his equipment so that it would fit into the space limitation provided. Fig. 1 shows the camera mounted on its carriage. As shown, it is intended for use in 16-in. mains. Legs of various lengths are provided for centering the camera in mains of 12 to 24-in. sizes, inclusive.

To see inside the pipe, a lighting system had to be developed. After several trials with various types and ar-

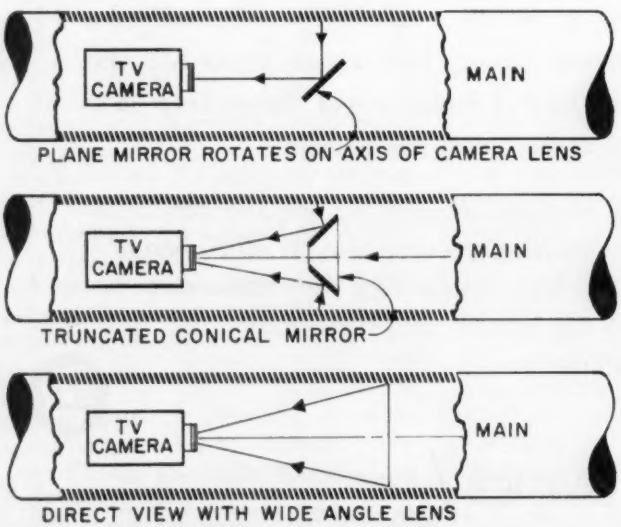


Fig. 3. Methods of viewing interiors of mains.

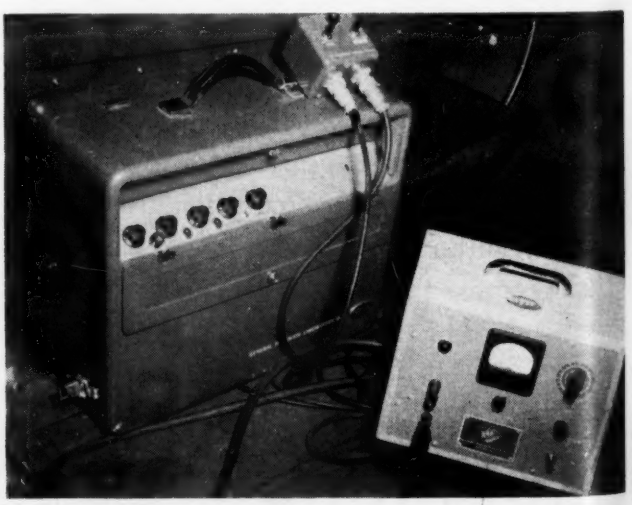


Fig. 4. Control equipment. At left, camera control unit. At top, control unit for focus and wiper motors. Lower right, power supply for focus and wiper motors.

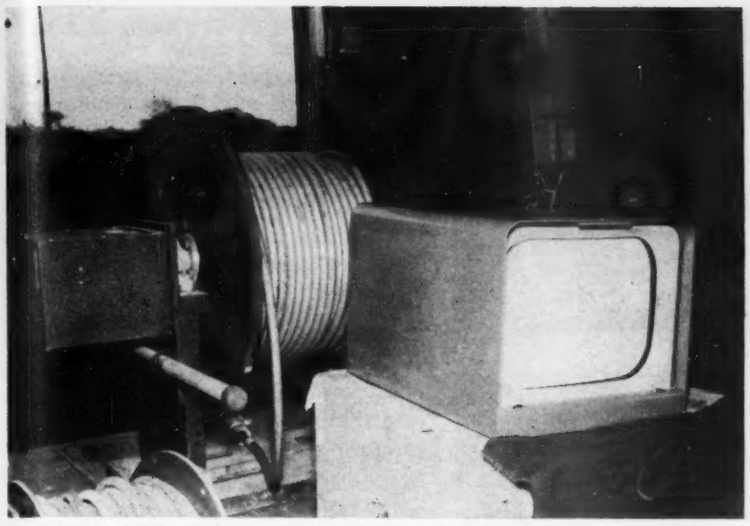


Fig. 5. At right is 14-in. monitor screen. At center is 24-conductor cable and reel. Lower left, portion of 120-v power supply cable and reel.

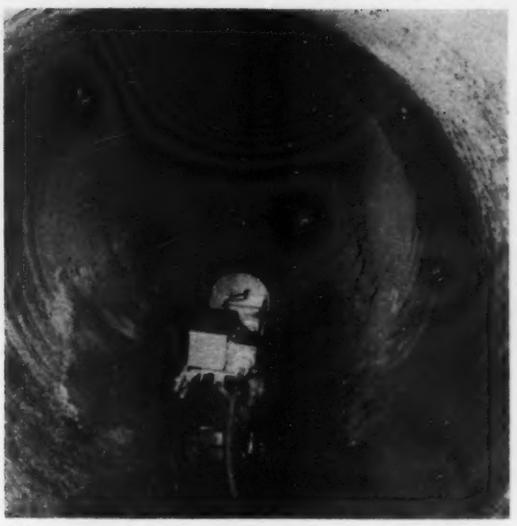


Fig. 6. Television camera inside of pipe. Push rods, each 20-ft long, are quick coupled to provide means of moving assembly in pipe.

rangements of lights, the system shown on the camera in Fig. 1 was adopted. It consists of twelve 20-watt spotlights with a protective shield.

Fig. 2 shows a rear view of the camera assembly on the carriage. At right is a connector for the 24-wire conductor. At lower right is the mechanical connection, for the push rods used to move the camera into the main.

Interior Viewing Methods

Three methods of viewing the inside surfaces of the mains have been tried. These are shown in Fig. 3. Part A shows a plane mirror, used for close inspection. In order to view the entire surface, the mirror is rotated.

To eliminate rotating the mirror (thus eliminating the need for a motor), a truncated conical mirror (Part B) was constructed so that the entire surface could be viewed. Through the hole in the center of the mirror assembly, the camera can also "see" forward to locate any possible obstructions that might damage the equipment. The image however, was badly distorted.

Part C shows the direct method of observing the interior surfaces by using a wide angle lens. Con Ed's cameras use methods A and C.

Because considerable dust is produced during cleaning of the inside surfaces of the joint, preparatory to sealing with one of the methods developed, the camera was totally enclosed and a windshield wiper provided on the window through which light enters to the camera lens and vidicon tube.

The wiper is operated from one switch on the control unit, shown in Fig. 4 atop the camera control unit. The other switch on this small control unit is for the focus adjusting motor. Also shown in Fig. 4 is the power supply for the windshield and focus adjustment motors, as well as the camera control unit that supplies the sweep and synchronizing signals.

Readers desiring further information about television equipment for viewing main interiors can obtain same by circling **No. 99** on the "Ready-Reply" card in this issue.

Other Equipment

In order to monitor the picture for the entire 400-ft travel of the camera,

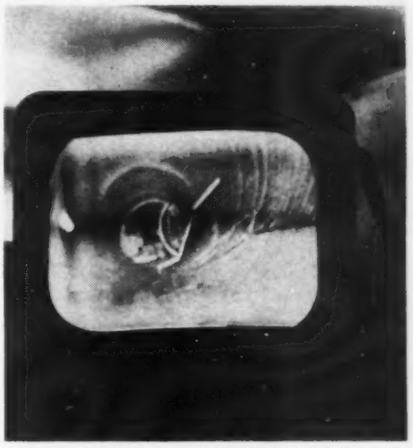


Fig. 9. Picture on monitor shows gate of valve in partially open position.

a 24-wire conductor cable and connectors are provided. It was necessary to adapt a 24-conductor concentric-contactor device—located in boxes at the sides of the reel supports—to allow the

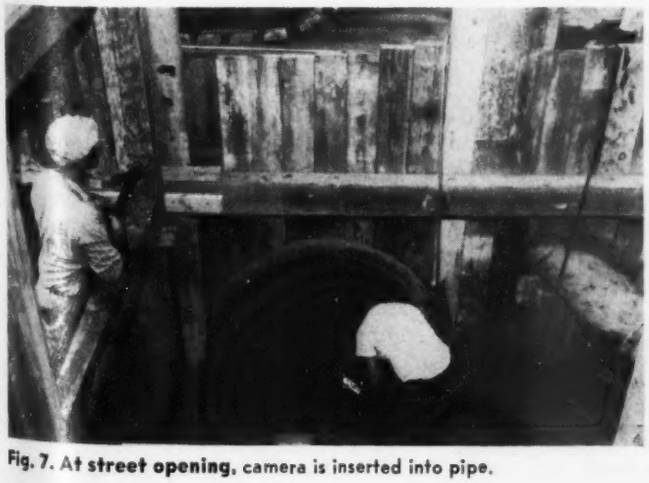


Fig. 7. At street opening, camera is inserted into pipe.

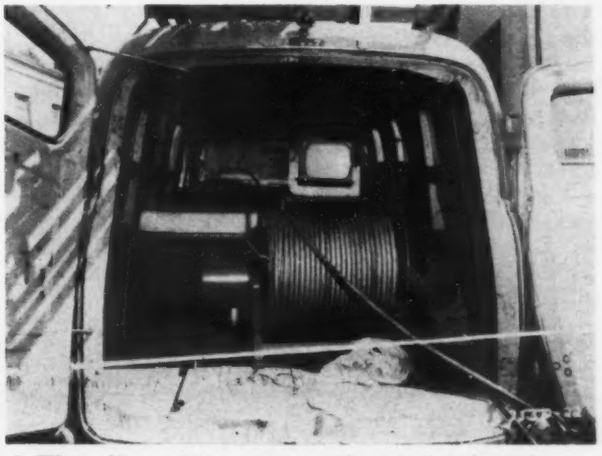
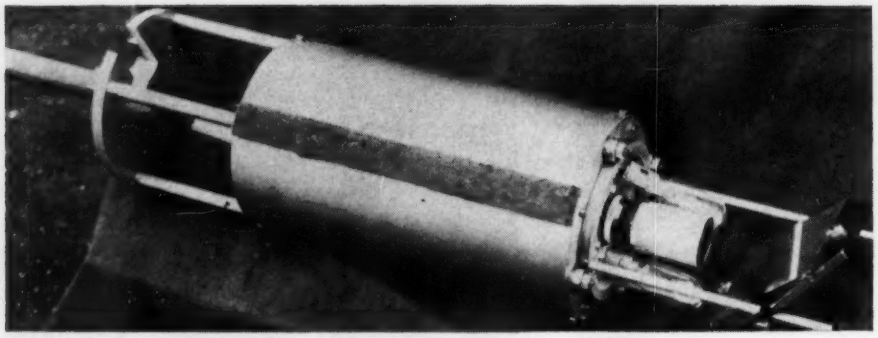
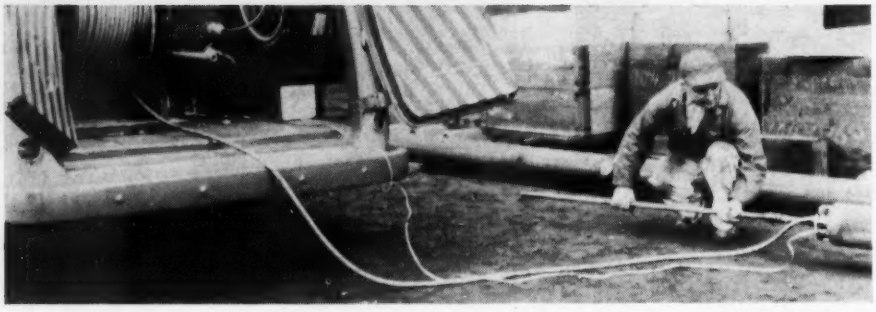


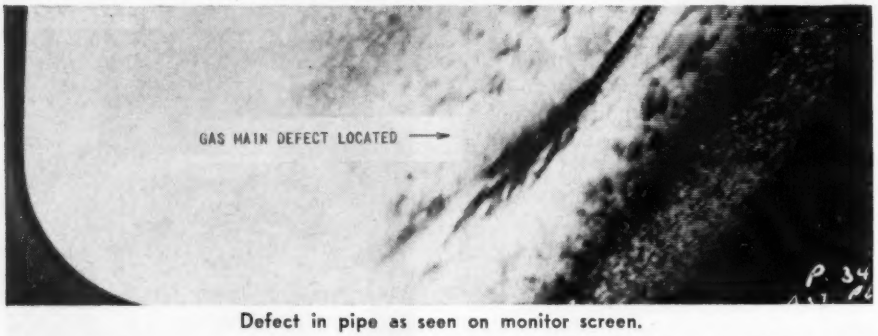
Fig. 8. TV monitor and 24-conductor cable on reel inside truck.



Compact TV camera is totally enclosed



Workman inserts camera into pipe.



Defect in pipe as seen on monitor screen.

Fig. 10. Development of television camera for internal inspection of gas distribution mains 6-in. OD or larger.

reel to wind and unwind. This is shown in Fig. 5 (top, center). Also shown is the 14-in. monitor (right) and, in the lower left, a portion of the cable reel for the 120-v supply line.

Fig. 6 shows the camera assembly moving inside a gas main. A street opening with men in the act of inserting the camera into a main is shown in Fig. 7. The camera is propelled into the pipe by means of pusher rods equipped with snap-on type quick couplers. As the camera travels into the pipe, 20-ft lengths are added.

A new design of cable reel on a truck is shown in Fig. 8, and the monitor can be seen further back in the truck.

Fig. 9 is a photograph of a picture as seen on the monitor screen. This picture shows the gate of a valve in a partially open position. In this case, the camera was used to supervise the task of jacking open the gate of a defective, abandoned valve in an abandoned main.

The valve is located in a very busy artery where traffic would have created quite a problem if an excavation had been made. Instead, an excavation was made in a side street, about 100 ft from the valve, and the men worked inside the pipe to jack open the valve to permit pulling a smaller size steel main through the abandoned larger main.

Operations inside the pipe were coordinated with the outside operations by viewing the monitor screen.

Smaller Camera

A smaller camera, for use in pipe of 6-in. OD or larger, is shown in Fig. 10. The camera is totally enclosed (top view) and slides on felt runners glued to its outside case. Note the lamps used to illuminate the inside of the pipe, as well as a revolving mirror set at an angle to the camera axis so that the side of the pipe can be viewed at an angle. The revolving mirror permits inspection of the entire inside surface of the pipe.

In the center picture of Fig. 10, the camera is being pushed into the pipe with the propelling rod attached. In the bottom picture is a view of a defect in the pipe as viewed on the monitor screen.

Recently developed (but not yet being used by Con Ed) is the 3-in. OD camera for smaller pipe, shown in Fig. 11.

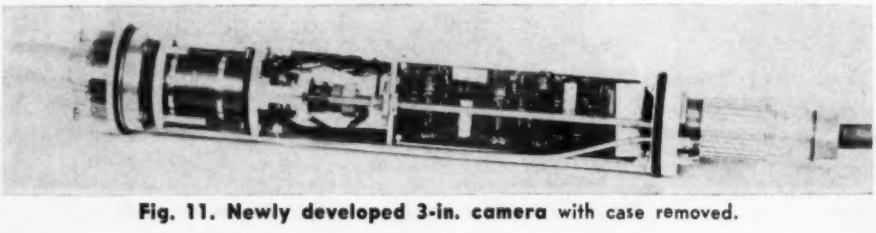


Fig. 11. Newly developed 3-in. camera with case removed.

Applications

There are many cases where this new tool can be put to work. Con Ed has used the TV equipment for inspection work on a considerable amount of internal sealing of mains using the Fuelling method. In one case, the camera was able to spot a pipe joint that had been "missed" by other joint-sensing equipment, and which had not been cleaned and coated.

Another problem encountered concerned a major leak in a steel main due to corrosion. Was it the only leak—or was the corrosion general in nature? General corrosion of the main might have meant abandoning it. With the TV camera, it was possible to check the main for additional holes, and—using a distance marker—tell exactly where they might be.

During the internal sealing operations, one main was found to accumulate a great deal of water when left overnight. This was a cast iron main with bell and spigot joints. Were the joints leaking water or was there another source?

Using the TV camera, it was found that the water came in through an abandoned gas light service connection that had been cut-off but never closed-off. It was at a low point and accumulated water that ran down the pipe into the main. Con Ed crews dug up the service and closed it off. That stopped the water and the sealing operation proceeded.

Occasionally, when using the camera, connections to the main are found that are not properly recorded on maps. The camera can also be used during construction to locate connections improperly mapped.

Acknowledgment

This article based on a presentation to the 1960 AGA Distribution Conference, New Orleans, Louisiana. * * *

BOOKSHELF

Computers and People, *by John A. Postley. Published by McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York. Price, $6.*

Written especially for readers whom computing systems are designed to serve — businessmen, managers, and other non-technical people — the book looks beyond the *how* to the *why* that dictates modern computers. Economics of computers are discussed, and the basic equipment described in terms that can be readily understood by the non-specialist. Includes an illustrative review of some present and forthcoming applications of computers.

Automatic Control: Principles & Practice, *by Werner G. Holzbock, Chief Engineer, Askania Regulator Company. Published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, New York. Pages, 266. Price, $7.50.*

Guide to the principles and applications of automatic control. Book begins with dynamic behavior of control systems, including static requirements and adjustments for peak performance. Covers mechanical and electrical components, measuring elements, controllers, and the specific part played by control valves. Final section describes various control systems and their specific applications.

Business Experience With Electronic Computers *by B. Conway, J. Gibbons, and D. E. Watts. Published by the Controllers Institute Research Foundation, 2 Park Avenue, New York 16, New York. Pages, 191. Price, $5.*

Analysis of survey results from 17 leading companies shows how expectations of the electronic computer have been modified since the days when the "giant brains" were expected to pare clerical expenses and relieve management of much decision making. Study synthesizes what the companies have learned in a decade of pioneering with electronic data processing equipment in areas of feasibility studies, preparing for the equipment, conversion to application, and operating the machines. Costs, generally speaking, have exceeded estimates, sometimes substantially, particularly in the area of programming and conversion.

The Second Treasury of Contemporary Houses, *selected by the editors of Architectural Record. Published by F. W. Dodge Corporation, 119 West 40th Street, New York 18, New York. Pages, 232. Price, $7.75.*

Utility personnel engaged in working with and selling ideas to architects, builders, and the general public will benefit from this excellent book of ideas on contemporary American home designs. Assembled by the editors of *Architectural Record*, this second "treasury" contains 44 of what the editors feel are the most significant houses designed during the past few years. All regions and climatic zones of the U. S. are represented, and the designs are the work of outstanding architects. All types of construction are included, and of special interest to gas utility personnel are details on heating and air conditioning facilities, and kitchen designs. Includes 400 photographs, drawings, plans. Hardbound.

1960 Registry of Industrial Radio Systems, *published by Communication Engineering Book Company, Monterey, Massachusetts. Pages, 229, Price, $5.*

Listings in this annually revised edition (15th) include mobile and relay systems operated by special industrial, forest products, power utility, petroleum and gas pipelines, relay press, motion picture, and VHF maritime services. Part 1 lists the systems by names and addresses of the licensees, showing location of the control points, frequencies, call letters, number of mobile units authorized, and make of equipment used. Part 2 lists the stations by operating frequencies.

Oscillations in Gas-Fired Heating Equipment and Their Suppression, *Domestic Gas Research Report published by the American Gas Association, 420 Lexington Avenue, New York 17, New York. Pages, 41. Price, $2.*

Report summarizes results of a research program on the causes and methods of suppression of combustion chamber and heat exchanger noises conducted at Battelle Memorial Institute under Project DG-8-GU. Research resulted in development of a theory on phenomenon of oscillation noises in furnaces and the potential means for handling them. Single and multiple-port burners were found to represent different phenomena which called for different procedures for resolving the problem.

The Influence of Convection and Radiation in the Over-All Heat Transfer of a High Temperature Gas-fired Industrial Furnace. *Research Report IK-10 issued by the Committee on Industrial and Commercial Research of the American Gas Association, 420 Lexington Avenue, New York 17, New York. Pages, 48. Price, $2.*

Report based on studies conducted for the Association at the laboratories of the Selas Corporation of America. Test results provide insight into technical phases of heat transfer for furnace builders and operators who are interested in the financial aspects involved in heating processes.

Directory of University Research Bureaus & Institutes, *published by Gale Research Company, 34th Floor, Book Tower, Detroit 26, Michigan. Pages, 208. Price, $20.*

Reference guide to university research bureaus, institutes, centers, experiment stations and laboratories contains over 1500 listings in 250 fields. Each listing includes official name of bureau or institute, address, name of sponsoring college or university, name and title of director, year founded, size of professional staff and non-professional staff, title and frequency of issue of serial publications, and a brief description of research program and activities.

Encyclopedia of American Associations Geographic Index, *published by Gale Research Company, 34th Floor, Book Tower, Detroit 26, Michigan. Pages, 174. Price, $15.*

New Geographic Index lists by state and city, all national associations, professional societies, labor unions, and other non-profit organizations listed in the basic volume, *Encyclopedia of American Associations*, (arranged by subject). Each listing carries the name and address of the association as well as name and title of chief official. Index includes a report summarizing the location of association headquarters. The survey shows that one half of all national organizations are headquartered in 3 cities — New York, Washington, D. C., and Chicago.

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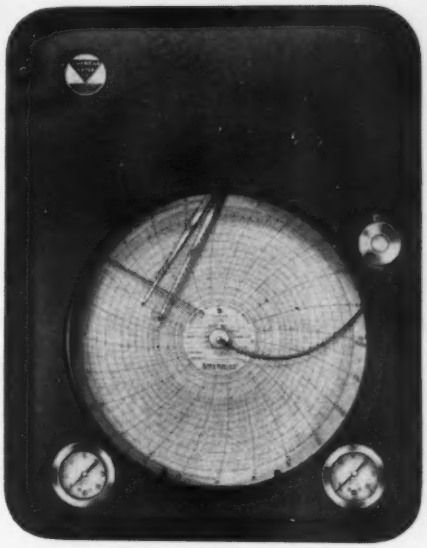

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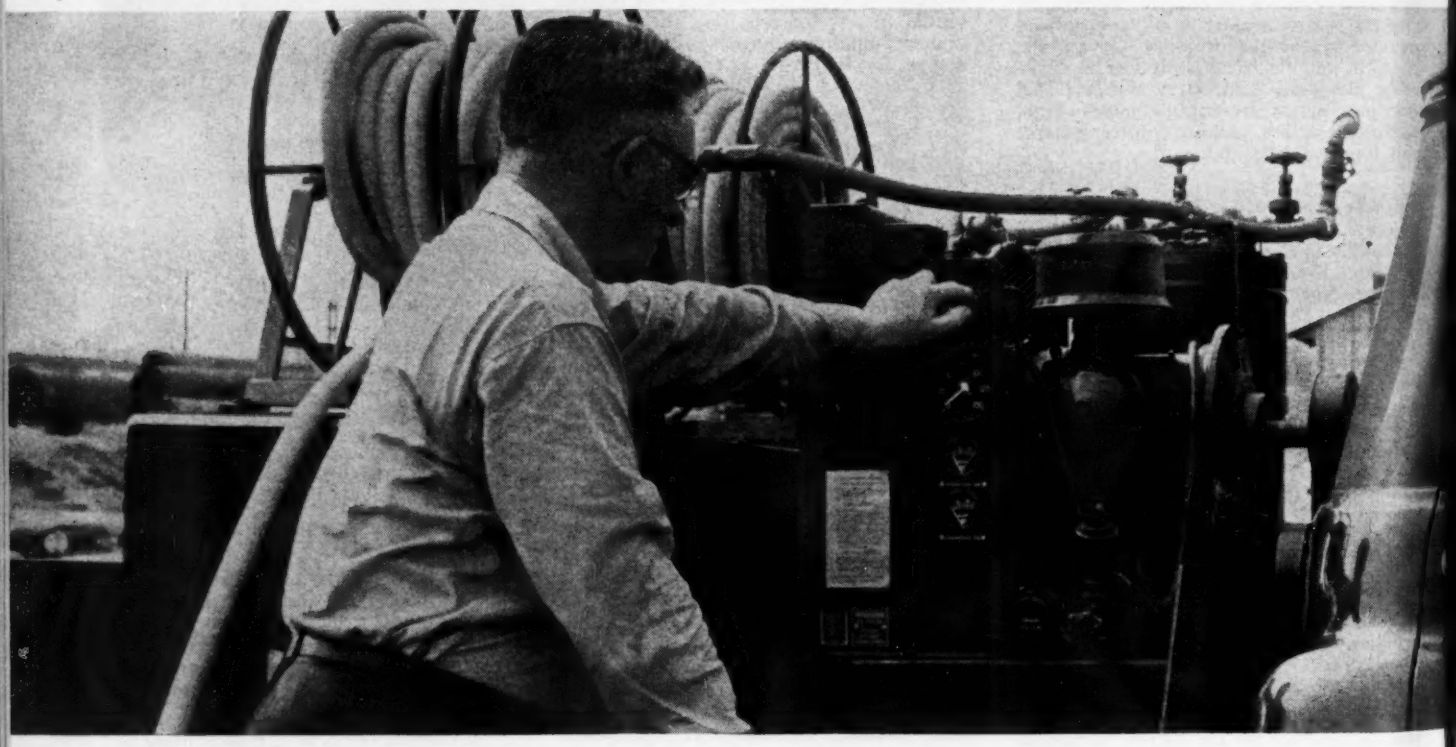

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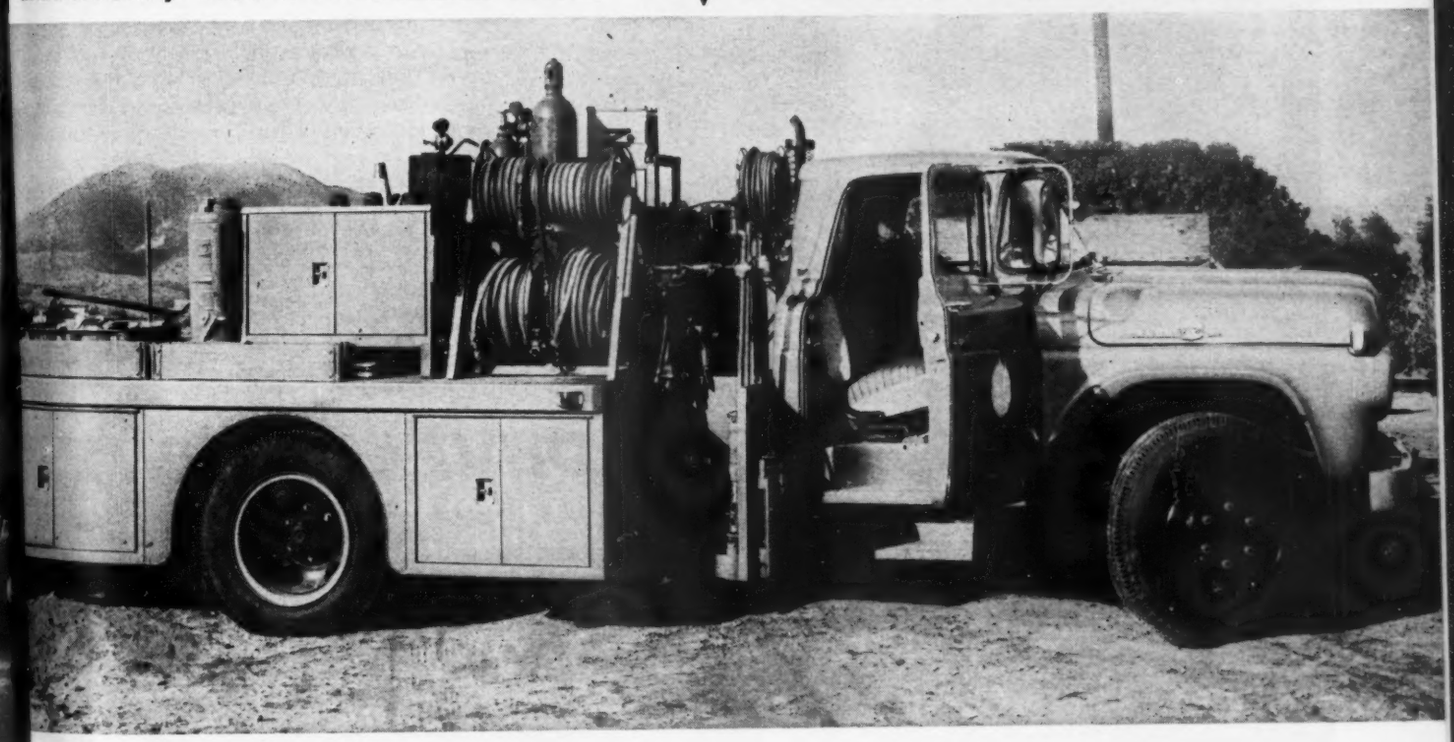

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More gas for Columbus. Several sections of welded line are lifted into position for lowering into the trench along Williams Road south of Columbus, as contractor crews for Ohio Fuel Gas Company move toward completion of a $45,700 construction project.

The Gas Service Company, Kansas City, Missouri, plans to construct distribution systems to serve three communities in northeastern Kansas. Twenty-year franchises have been granted by the municipalities of Troy, Wathena and Elwood, and the company's application for certificate of convenience has been okayed by the Kansas State Corporation Commission.

Houston Natural Gas Company, Houston, Texas, has rerouted a 12-in. loop line along Calhoun Road near the Gulf Freeway because of the new Elgin-Lockwood highway interchange, that called for an underpass 24 ft deep which would cross the HNG main. In an unprecedented action, city granted company privilege of suspending the line down the middle of the bridge under the pavement. To accomplish the relocation, HNG removed 400 ft of 12-in. and replaced it along the new route with 680 ft of 12-in.

In Dickinson, 27,000 ft of 4-in. main line were purchased from Houston Pipe Line to become part of the city's distribution system. Two city gate stations, also part of the transfer, will be converted to regulator stations. Newly-built North City gate station is a joint HNG-HPL project. Houston Natural recently installed several thousand feet of 6 and 2-in. line to serve River Woods, a new Northeast Houston subdivision which eventually will contain 1135 homes.

DISTRIBUTION DEVELOPMENTS

NEWS ABOUT CURRENT AND PLANNED CONSTRUCTION

New Orleans Public Service, Inc., New Orleans, Louisiana, plans to install approximately 100,000 ft of 1 to 10-in. steel mains for new business at various locations within the City of New Orleans. Approximately 75,000 ft will be high pressure line. Company also plans to install 122,000 ft of ¾ and 1½-in. steel services for new business; 5000 ft of 1 to 8-in. steel mains to replace old cast iron mains for system improvement; and 58,000 ft of 4 to 12-in. low pressure steel mains replacing cast iron mains in advance of street paving. All work will be done by company crews. Recently completed was a project calling for the installation of a high pressure main and service to the Post Office building to be erected on Loyola Avenue near the Union Passenger Terminal; 1130 ft of 6-in. steel high pressure gas main, one 6-in. steel high pressure gas service 51 ft long, and three 1-in. steel high pressure services were installed.

Working ahead of a street paving project, construction crews of New Orleans Public Service replaced approximately 572 ft of cast iron mains with 6-in. steel mains, extending and rearranging services as needed.

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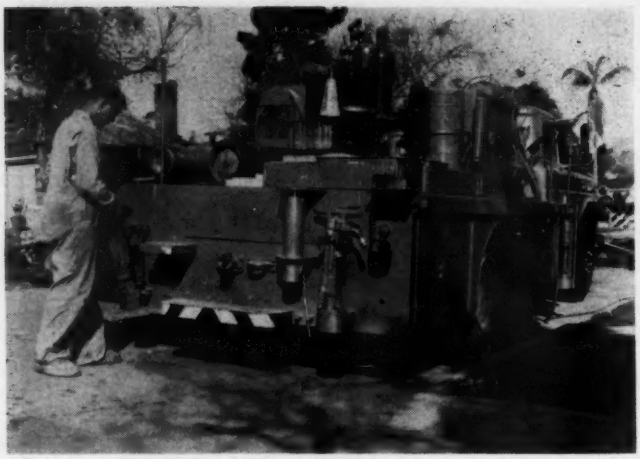

New service truck now undergoing tests by Southern Counties Gas Company, Los Angeles, features side-mounted power take-off equipment, bins on the sides for tools, and special mountings for jack hammers at rear of truck. John Strawhorn, Santa Monica Bay division field assistant, (upper left) shows how jack hammer is easily removed. Oscar Hogue, lead mechanic in the division, (lower left) inspects the power take-off equipment, while Marshall Anderson, crewman, (below) checks equipment in the built-in locker and tool storage bin. Pipe racks are conveniently located along the left side of the new truck.

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Developments

Boston Gas Company, Boston, Massachusetts, plans to change over from 900 Btu to straight natural gas in areas not already on straight natural gas in 1960. Last year, company made its greatest gain in gas sales, added 4150 central heating installations and 4800 kitchen heating and room heating installations. Of new homes accessible to company's lines, 3 out of 4 were equipped with gas central heating.

Washington Natural Gas Company, Seattle, Washington, plans to continue development in 1960 of a distribution system capable of serving between 3000 and 4000 residences and commercial establishments on Mercer Island located in Lake Washington east of Seattle. A 4000-ft crossing of the East Channel of Lake Washington connecting Mercer Island was completed last year. Plans for complete encirclement of the 26-mile long Lake Washington are rapidly materializing; extension of natural gas supply mains to Bothell constituted an important step in the program and raised to 28 the number of incorporated communities served by WNG.

Equitable Gas Company, Pittsburgh, Pennsylvania, plans to spend more than $11,000,000 in 1960 on new plant construction, with $1,840,000 tabbed for the second segment of the 71-mile Lumberport-Pittsburgh supply line improvement project. First segment of the project, 13 miles of 16-in. line, was installed in West Virginia in 1959 at an estimated cost of $1,050,000.

Also planned for 1960 is continued development of the Rhodes storage pool. At the end of the 1959 injection cycle, pool contained more than 3,800,000 Mcf, or more than ⅓ of its estimated total capacity. This brings Equitable's underground gas storage total to 33,138,031 Mcf in 14 pools. In the past several years Equitable has developed underground gas storage capacity to meet its need for peak day and winter season gas supply. System limitations, however, restricted company's benefits from such a plan. In order to improve daily gas deliveries, Equitable undertook a long-range (thru 1964) improvement program that calls for installation of 71 miles of 16 and 20-in. high pressure line looping of its transmission system from Lumberport, West Virginia, to the Pittsburgh distribution system.

Another project planned this year is expenditure of $60,000 in the Monongahela area for service improvements. Construction is now underway on replacement of 8334 ft of old line, and installation of 4779 ft of new line in the area.

Alabama Gas Corporation, Birmingham, Alabama, has construction underway on a $2,000,000 expansion of its distribution system in the Birmingham metropolitan district. Nine miles of a 50-mile 12-in. loop line that will encircle Birmingham area, has been completed. One 7-mile section begins at a point 2 miles north northeast of the East Lake section of Birmingham and extends east to a point beyond Center Point area. Another 2-mile section has been completed in the area between New Merkle (Cahaba Heights) and the Old Leeds Road south of Birmingham. The New Merkle-Old Leeds Road loop section is called the "bubble," and presently serves as a storage facility for reserve supplies of gas. Held at high pressures, this reserve assures adequate gas supply to the surrounding area during periods of extreme temperatures; "bubble" presently serves the fast-expanding residential areas to the south of Birmingham including Shelby County.

Nashville Gas Company, Nashville, Tennessee, spent more than $1,353,438 last year for construction and improvements of its gas distribution system and to install 41.4 miles of new main and add 1123 new customers. Approximately $961,404 of the total budget was spent to extend mains into new areas such as Ashland City and Goodlettsville. Nashville Gas successfully increased by 19 percent the number of new houses using gas heat in its service area in 1959 over 1958 largely due to getting builders to install gas heating equipment in houses selling in the $12,000 bracket and above.

Northern Illinois Gas Company, Aurora, Illinois, has added the 285th community to its distribution system — Shorewood. Brief turn-on ceremonies were conducted late in January at home of Robert F. Schwartz, member of the village's Board of Trustees. Company installed 35,000 ft of new gas mains to and within the village of Shorewood.

NI-Gas spent approximately $40,443,000 on construction in 1959 nearly double the 1958 total. Plans for 1960-64 include estimated expenditures of $180,000,000, with $33,000,000 earmarked for underground gas storage facilities. Largest single item is a $10,000,000 75-mile supply line to be built this year to connect Troy Grove storage reservoir with company's distribution system near LaGrange. During 1959, NI-Gas installed more than 825 miles of new mains, added 43,298 new customers, and sold more than 150,890,000,000 cu ft of gas or 17 percent more than in 1958.

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GENERAL PRODUCTS DIVISION
HAYS MFG. CO.
ERIE, PA.

Distribution Developments

Elizabethtown Consolidated Gas Company, Elizabeth, New Jersey, plans to spend approximately $2,800,000 for new construction in 1960. This compares with $1,941,986 spent in 1959 and $2,210,878 in 1958. Company added 1.9 percent more total customers during 1959 bringing the total to 145,365. Final plans and specifications for a proposed $1,100,000 street and service center in Woodbridge Township to serve the southern portion of Elizabethtown's territory are being completed. Located near U. S. Highway 1, the New Jersey Turnpike, and Garden State Parkway, the new service center is to be completed by mid-1961.

Laclede Gas Company, St. Louis, Missouri, mailed 5000 permits for conversion to gas heat in March to residential customers in existing homes who had applied previously. Permits, first issued since the last heating season, are possible because of continued successful development of underground storage facilities at Florissant, Missouri. New release brings to more than 100,000 the number of residential heating customers served by the company.

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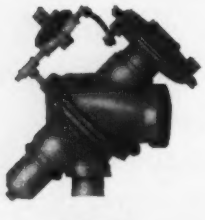

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GEM

REYNOLDS GAS REGULATOR CO., INC., ANDERSON, INDIANA

A SUBSIDIARY OF ARKANSAS LOUISIANA GAS COMPANY

Brooklyn Union Gas Company, Brooklyn, New York, has construction underway on all five sections of its 30-in. Jamaica Bay Line *(AGJ May '60)*. Section 1 from Colonial Road and 86th Street to East of 23rd Avenue and 83rd Street involves installation of 16,516 ft of 30-in. by Mackay Construction Corp. Section 2 runs East of 23rd Avenue and 83rd Street to East of Ocean Avenue and Avenue S and includes 10,762 ft of 30-in. and 22 ft of 12-in. being installed by Delee General Construction Corp. Section 3 from East of Ocean Avenue to EPL of Paerdegat Avenue S and Avenue U involving 16,780 ft of 30-in. was begun April 25 by Tully & DiNapoli, Inc. Oakhill Contracting Co., Inc., is contractor of section 4 which runs from WPL of Paerdegat Avenue N and Seaview Avenue to Linden Boulevard and Pennsylvania Avenue; project includes 14,122 ft of 30-in. and 2,360 ft of 24-in. Section 5 — 625 ft of 30-in. and 2000 ft of 24-in. from EPL of Paerdegat Avenue S and Avenue U to WPL Paerdegat Avenue N and Seaview Avenue — is being installed by contract crews of Merritt-Chapman & Scott Corp. All construction on this line is expected to be completed by September.

Atlanta Gas Light Company, Atlanta, Georgia, has completed installation of a 2-in. line on College Park Road south of Atlanta as part of a pressure improvement operation. A 6-in. high pressure line will be extended from this line to serve Delta Air Lines' jet aircraft maintenance building at the Municipal Airport.

Iowa-Illinois Gas and Electric Company, Davenport, Iowa, plans to spend an estimated $3,500,000 on new gas plant construction in 1960. During 1959, company spent more than $4,500,000 on new construction which included 11 miles of parallel feeder line between the supplier's pipeline and Iowa City, a 12-in. line extending 5 miles cross-town in Cedar Rapids, and feeder lines, street mains and customers' services required to supply Hiawatha, Iowa, and six additional communities in the Quad-Cities area, two in Iowa and four in Illinois. Approximately 6167 new gas customers were added, bringing the total number of customers to 132,577. Plans for 1960 include extension of gas service into additional fringe areas of the Quad-Cities and to two new towns in the district having a total population of about 3300. Contingent upon authorization by the FPC and availability of steel pipe, Iowa-Illinois also expects to expand its service lines to serve three small communities in the Fort Dodge district.

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Distribution Developments

Iowa Public Service Company, Sioux City, Iowa, plans to spend approximately $660,000 for new construction on gas distribution systems in Evansdale, Elk Run Heights, Raymond, Washburn, Gilbertsville, Janesville, Jesup all in the Waterloo area and Goldfield, near Eagle Grove. Construction will get underway as soon as contracts have been let. Northern Natural Gas Company, supplier for IPS, has announced it will begin construction in June of pipeline laterals and town border station facilities to supply natural gas to the eight towns.

Central Hudson Gas and Electric Corporation, Poughkeepsie, New York, has awarded the contract for installation of the 10-in. natural gas line from Kingston and Highland *(AGJ March 1960)* to C. N. Flagg and Co. of Meridan, Connecticut. Clearing and grading of the route are now underway and contractor crews began laying the pipe in the trench in early May.

Southern Union Gas Company, Dallas, Texas, has installed a natural gas irrigation project near Tularosa consisting of approximately 17 miles of 4½-in. steel and 2-in. plastic gas mains to serve gas to a number of farm residences and some 50 irrigation wells. Bennett Line Construction Co. of Lubbock, Texas and L. V. Jackson & Sons Construction Co. were contractors on the project. About 80,000,000 cu ft a year will be used to operate the 50 wells now incorporated in the project; another 50 wells are expected to be added within a year.

Iowa Power and Light Company, Des Moines, Iowa, hopes to initiate gas service in 22 communities this year as a result of additional gas supplies from Northern Natural Gas Company, and has agreed to a total contribution of $261,000 toward construction of city gate and measurement stations to receive the additional supplies. However, two other natural gas distributors who purchase their gas supply from Northern Natural have appealed the FPC order on the premise that contributions required from some communities should be materially greater than that prescribed by the FPC. This has delayed construction on the project. During 1959, Iowa Power installed natural gas distribution systems in Carlisle and University Park adding several hundred new customers. In all, company added 3197 new gas customers last year bringing the total to 89,904.

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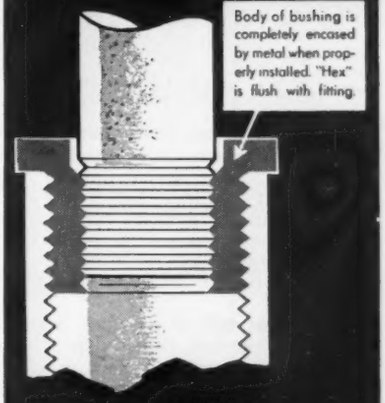

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PRODUCT PARADE

MATERIALS – EQUIPMENT – SERVICES

Dozer angles 36 deg from operator's seat. New 87-in. Hyteco dozer can be angled as much as 36 deg, saving time by eliminating "dead heading." Dozer has lift of 4-in. and will work 24-in. below ground level. Inside mounting of the frame makes side draft negligible.

CIRCLE (1) ON THE REPLY CARD

Infra-Red gas burner provides from 150 to 3000 Btu per linear inch, depending on the gas-air mixture supplied, at only a fraction of the cost of equivalent electrical energy. Combustion takes place completely within the fluted refractory. The burner is particularly suitable for oven, conveyor, rotary drum, and roll dryer applications as a combustion chamber is unnecessary and the flame is stable even under high velocity circulation. Burners can be made in any desired lengths from 7 in. to 100 ft or more.

CIRCLE (2) ON THE REPLY CARD

Glass fabric hose recently developed by The Flexaust Company for moving hot air or fumes is now available in sizes from 1½ to 24-in. ID. Made of neoprene coated fiber-glass fabric, it is spiral wire reinforced. Lightweight, and extremely flexible, this hose has exceptional flame resistance and high burst strength. Glass hose is designed for both permanent and temporary use in air handling and fume control applications. Operating temperature range is from −40 to 300 F.

CIRCLE (3) ON THE REPLY CARD

Snap-Mount backhoe attachment for Michigan Models 55A, 75A, and 85A tractor shovels is a fully hydraulic backhoe that can be snapped on or off a tractor shovel in less than a minute without tools. Backhoe has 180 deg continuous swing, a 180 deg bucket tilt; a 12 ft 4-in. digging depth; 10,000 lb breakaway at bucket teeth; and 15 ft 6 in. reach from center rotation. Counterbalance is included for use when the hoe is disconnected.

CIRCLE (4) ON THE REPLY CARD

Uniform furnace temperature for heat treating processes, regardless of uneven loading, can be obtained by using excess air with North American's new sealed-in nozzle mix gas burner. Uniform temperature is achieved by lowering gas intake while maintaining an excess air rate. Burners are available with air pipe sizes of ¾ to 1½-in. Range of 70,800 to 431,000 Btu per hour is possible at an air pressure of 16 osi.

CIRCLE (5) ON THE REPLY CARD

1960 J. I. Case utility tractor line includes three new wheel and crawler tractors. Model 530 wheel tractor is powered by 47-hp high-torque gasoline engine with 90 percent assist power-steer and synchronized shuttle transmission for easy maneuvering and fast loading cycles. Unit is available with 2000-lb loader, loader and 14-ft backhoe, or as a drawbar unit. All-new Case-built backhoe for this model cuts 14 ft deep, digs 16 ft 9 in. from pivot, and operates thru 180 deg arc; 8 backhoe buckets, including bellhole types, are available. Second model, a new economy wheel tractor called the 430 and constructed basically the same as the model 530, is powered by high torque 38.5-hp gasoline engine, has 4-speeds forward, one reverse as standard equipment, with 8-speed shuttle transmission, power steering, and "all traction utility" tires. Third model, the 310D utility crawler tractor, gives 5815 lb pull and push-power for use as a loader, bulldozer, angling dozer, loader-backhoe, or drawbar unit.

CIRCLE (6) ON THE REPLY CARD

Higher capacities, lower prices have been announced for Mettler junior "Fan-Air" burners. Initial low cost of the automatic gas burner units, combined with their wider capacity range, opens new opportunities for moderate-investment conversions of furnaces, boilers, incinerators, and process equipment. Patented spark-ignited rectifier safety pilot and electronic flame safety relay protect against flame failure.

CIRCLE (7) ON THE REPLY CARD

Latest addition to Wheeler Manufacturing Co.'s pipe cutter line employs hydraulic power for use on 2 and 3-in. cast iron mains. Ideal for use in close quarters and on over-head installations. Ruggedly built, lightweight, and compact, the unit uses a chain that is simply wrapped around the pipe with the nearest chain pin engaged in the jaws. Pump is then operated until the cut is accomplished. Unit is supplied with sufficient cutting chain for 2 through 8-in. pipe.

CIRCLE (8) ON THE REPLY CARD

U-Seal for cased crossings, developed by T. D. Williamson, Inc., provides maximum flexibility for any crossing installation, and maintains its seal regardless of change in pipe position in relation to the casing — up, down, sideways, in, or out. This flexibility permits installation on wide ranges of coating thickness for any given pipe size, unusual pipe casing combinations can often be sealed with standard size seals. Two stainless steel bands hold seal firmly in place. Only a screwdriver is needed to tighten the bands.

CIRCLE (9) ON THE REPLY CARD

Job-planned utility bodies for the 1960 Chevrolet and GMC three-quarter ton chassis, now available from Reading Body Works, provide lower center of gravity to increase roadability and maneuverability for entire vehicle. Lowered body dimension affords unobstructed vision from rear window of cab. Front storage compartments, complete with adjustable and removable dividers and removable shelves, have been increased in length and lowered to complement streamlined design of new Chevy's and GMC's.

CIRCLE (10) ON THE REPLY CARD

Bus Brown Trencher's newest and largest model, 468R, weighs 350 lb more and offers more trenching width than its predecessor Model 346. Self-propelled, new unit has variable trenching speeds up to 12 ft per minute and will trench ditches up to 12-in. wide. Unit retains popular 4-wheel drive of earlier model, and is balanced on its two front wheels for easy steering while moving forward and loading.

CIRCLE (11) ON THE REPLY CARD

New pipe turning wrench uses torsion to exert positive smooth grip around entire circumference of pipe. Wrench is designed to turn round and odd shapes of pipe and tubing without slipping, scratching or gouging the surface, or distorting the shape; combines advantages of chain and strap wrenches with the use of torsion action. Made of aircraft quality steel, wrench will withstand 13,000 psi torque without slippage.

CIRCLE (12) ON THE REPLY CARD

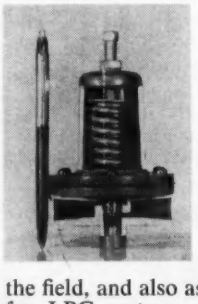
Oxygen-supplied rescue breather named the "Samaritan," is now available from Globe Industries, Inc. Used as an oxygen resuscitator, unit is not dependent on compressed oxygen as a source of power to operate a mechanical resuscitator valve. As a breathing assistor, unit may be used with or without oxygen to aid people having difficulty in breathing caused by asthmatic attacks or other illnesses; or by the inhalation of irritating gases. May be used as a demand inhalator for resuscitated patients who must be continued on oxygen. Patient receives oxygen at the rate he "demands." Easy to carry, unit weighs only 26 lb complete with fully charged cylinder.

CIRCLE (13) ON THE REPLY CARD

Size range of Tube Turns' taper-face welding neck flanges has been extended to include 14 through 24-in. pipe sizes. Lightwall construction reduces disparity in strength between it and mating Class 125 cast iron flanges, thus avoiding the hazard of breakage. Slight taper of flange face (top) concentrates gasket pressure near the bore, requiring low sealing force. New larger sizes are rated for 150 psi gas service.

CIRCLE (14) ON THE REPLY CARD

Versatile instrument regulator, recently introduced by Rockwell Manufacturing Company, is applicable wherever a controlled supply of air or gas pressure is needed, either in commercial, industrial, or utility operations. Unit is suited for controlling inlet pressures on sensitive controlling, regulating, and recording devices in the field, and also as a first stage regulator for LPG systems. Maximum inlet pressure is 250 psi, outlet pressures range from 0-5, 5-35, and 35-100 psi.



CIRCLE (15) ON THE REPLY CARD

Computer typewriter with automatic sequence control, provides optimum automation to utility billing and many other office routines. A complete departure from conventional automatic billing machines, new computer typewriter relieves operator of necessity for making routine decisions and taking action to obtain desired results. Figures are properly computed, regardless of their position on form; all extensions, sub-totals, and totals are automatically typed. Description of taxes, discounts, and rates, plus associated calculations are also automatically printed, without recourse to manual keystrokes, through stored program control.

CIRCLE (16) ON THE REPLY CARD

High-powered "Handie-Talkie" pocket receiver assures reliable voice communications even in noisy locations. Unit provides 500 milliwatts audio output, 5 times the power of previous units. Is available for operation on 25-54 megacycle and 144-174 megacycle frequency bands — standard 2-way mobile radio channels.

CIRCLE (17) ON THE REPLY CARD

ISOMETRIC PIPING TEMPLATE designed for gas company engineers, operations supervisors, draftsmen, and piping designers, is a new, easy-to-use tool that facilitates sketching all types of pipe layouts in standard isometric form. Because of its simplicity, even a beginner can make professional isometric drawings with it. Pocket size, the template is made of a laminated, clear, heavy-grade plastic, has cut-outs for most common piping and fitting symbols, rounded corners for uniform angles, and handy compass orientation points.

CIRCLE (18) ON THE REPLY CARD

Resilient seated butterfly valve offers many advantages for flow applications where positive, drop-tight shutoff and or resistance to corrosion are important. Smaller in overall dimensions and weighing only a fraction of that of a gate valve, the Rockwell butterfly valve is available in sizes from 2 to 36-in. in both 50 and 150 lb pressure ratings. Disc seats against resilient seat liner of molded, abrasion-resistant rubber or synthetic elastomers that snap fit easily into the body. There are no mating metal surfaces to corrode or bind, no voids or cavities in valve body to cause eddy currents or fouling with foreign matter. Pressure drop is extremely low.

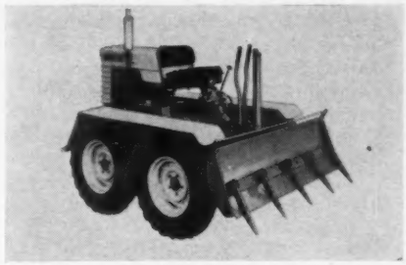
CIRCLE (19) ON THE REPLY CARD

Fiber-glass outer wrap for protection of underground pipe lines can be used for both hot and cold wrapping applications, will not stretch unduly, shrink, sag or rot underground. Bitumen-saturated, the outer wrap resists impact and soil stress and is not affected by acids and fungus. Standard widths are 2, 3, 4, 6, 9, 12, and 18.

CIRCLE (20) ON THE REPLY CARD

Seamless steel welding fittings in all sizes ranging through 24-in. have been added to Midwest Piping Company's line of welded-type fittings. Each fitting is hot coined—sized in compression for its entire length, to produce true overall roundness that permits segmenting at any point. Ends of each fitting are machined inside and out to insure circle-perfect roundness; both ends are machined simultaneously, with the fitting in a fixed position, to assure fittings that are plumb and square.

CIRCLE (21) ON THE REPLY CARD



FOUR WHEEL DRIVE TRACTOR designed for light industrial and construction work is available from Detroit Tractor, Ltd., in four different, hydraulically operated models—bulldozer, grade clamp, roll bucket, and loader. New controlled differential steering gives a turning radius of 12 inches. Operator is seated forward for excellent visibility in the working area plus better operating balance. Other features are: Double acting hydraulic cylinder with float position valve, and a new fast service design that allows easy removal of clutch or transmission. Free catalog sheet describes unit.

CIRCLE (22) ON THE REPLY CARD

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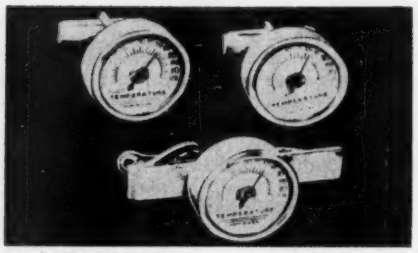
New temperature data recording system measures and records up to 75 iron constantan thermocouple inputs; can be used in applications where periodic, accurate recording of temperatures is desired on either round-the-clock or intermittent basis. Digital output is presented automatically on an electric typewriter. System consists of an input scanner, self-balancing potentiometers, shaft encoders, encoder selector, control chassis, programmer, digital clock and an electric typewriter. Three temperature ranges are provided: −30 to 120 F, 250 to 600 F, 0 to 1200 F. Scanning rate is 3 seconds per data point. Scan cycle can be initiated manually or automatically.

CIRCLE (23) ON THE REPLY CARD



THERMOMETER TIE CLASP AND CUFF LINKS. Circular dial-type instruments distributed by Zinn Originals of New York have non-breakable crystals and are calibrated from minus 20 deg F to plus 120 deg F. They are easily read, and sensitive to within one degree. Gift boxed, silver plated or gold plated. Tie clasp, $2.75; cuff links, $5.50.

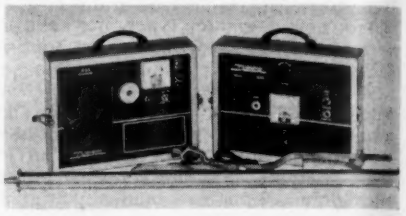
CIRCLE (24) ON THE REPLY CARD

Compact Trailers for compact cars. Carry-All Trailers, Inc. has recently introduced a utility trailer designed and automotively engineered for the small car market. Trailers are constructed of heavy 16-gage pressed steel welded to the frame for unitized construction, have precision axles, hi-speed wheels, European type square tubular frames, and stop-tail lights with turn signals.

CIRCLE (25) ON THE REPLY CARD

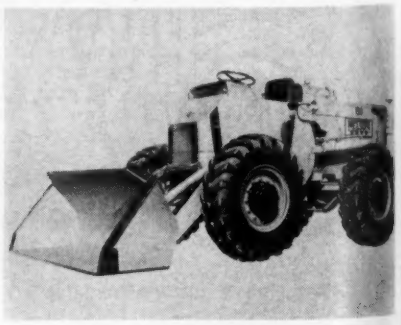
Portable power pipe threader – weighing only 20 lb — threads ¼ to 4-in. pipe on the job or in the shop. A versatile tool, it will thread bolts, and with an auger, it will dig holes; used with a portable winch, it will lift up to 1000 lb easily. Can be used to open and shut valves, and pull tubing through casing.

CIRCLE (26) ON THE REPLY CARD



DETECTRON TRANSISTOR PIPE DETECTOR, now being produced by Computer Measurements Company, has eliminated the inadequacies normally inherent in transistors, such as heat limitations, by use of special compensating circuitry. New model is suitable for use in hot southern climates where heat instability of transistors has previously been a problem. Unit traces pipes and cables by the conductive method — which is of particular advantage in areas where highly mineralized soil is a problem, or where there are many abandoned pipe lines. Cut-off of the new unit is unusually sharp assuring separate detection of pipelines lying close together. Not only designed to detect and trace pipes, cables, conduits, unit can locate valve boxes, services, studs and miscellaneous metallic objects. Depth range on 1-in. water pipes approximates 10 ft, and maximum depth range of the instrument on large lines is 20 to 25 ft depending on soil conditions.

CIRCLE (27) ON THE REPLY CARD



N. P. NELSON IRON WORKS has added a new 1⅝ cu yd capacity model to their tractor-shovel line. Features of the new model "150" include Nelson underslung bucket arms with 100 percent operator visibility and safety; 40 deg tipback bucket at ground level; maximum dumping height, under bucket edge, of 9 ft; and forward reach at 7 ft dumping height of 5 ft 2 in. Unit has three speeds forward and reverse ranging from 3.3 to 27 mph. Unit is powered by either a Hercules G-298H, 107 hp gas engine, or a Hercules D-298H diesel. Weight of gas model is 15,700 lb.

CIRCLE (28) ON THE REPLY CARD

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2. UNACCOUNTED-FOR GAS

3. DANGEROUS HAZARDS

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Yes, all of these problems can be reduced, or **eliminated completely** with the proper application of a cathodic protection system using Standard Magnesium Anodes.

Standard Magnesium Anodes are designed to protect against **ALL** corrosion of your gas lines. For further information on how these anodes can help you prevent leakage contact:

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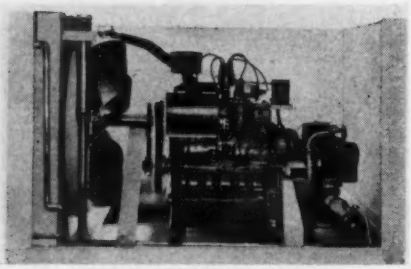

Natural-gas-powered air conditioning systems in 5 and 7½ ton capacities for residential or institutional use have been developed by Gas-cool Division, Vector Engineering Contractors, Inc. Average fuel requirement is only 20 cu ft of 1000 Btu gas per-ton-hour of operation. Unit is powered by the Continental engine developed under PAR program of A.G.A. May be installed either outdoors or on the roof; requires only 2 connections to cooling coil in the duct system. Gas-cool unit features completely automatic thermostatic temperature control and extremely low operating noise level as a result of the design of the fiber glass insulated cabinet and special muffler installation.

CIRCLE (29) ON THE REPLY CARD

New 2-in. "Arrow" gas filter eliminates accumulation of dirt in the meter and pilot, virtually eliminating repeat service calls on gas meters. Unit filters down to 5 microns. Constructed to give 250 sq in. of filter area, unit has been approved in installations by leading gas companies.

CIRCLE (30) ON THE REPLY CARD

PRODUCT

TINIEST PINHOLES or other leaks around joints in gas pressure lines can be located with *Detect-A-Leak*, a non-inflammable, non-corrosive liquid, manufactured by Flamort Chemical Company of San Francisco. Substance is not a soap, is packaged in handy 8-ounce containers with an applicator brush attached to the cap for quick, easy brushing over threads, fittings, or other suspected areas. When applied to pressure lines, substance immediately forms large bubbles which remain intact until the danger spot can be marked for repair. Can be used on rubber, plastic, or any type of metal or other material without damage.

CIRCLE (31) ON THE REPLY CARD

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PARADE

Quick, safe meter installations are possible using Eclipse's new malleable iron return bends that reduce the number of threaded joints in meter installations, save pipe-fitting time, and make sure piping of meter sets is parallel. Two types of bends are available — plain or wedgeseal-insulated to stop induced or stray house currents from underground services and mains.

CIRCLE (32) ON THE REPLY CARD

High-pressure unions for 2-in. pipe feature a fast "make-and-break" for ease of installation and maintenance of pipeline systems. Both the new 4000 and 6000-lb working pressure unions have a full 3-pitch acme thread that turns easily, resists being clogged by foreign matter, and can be cleaned quickly. In addition to providing easier make-and-break union, the acme thread withstands considerably more physical abuse than a conventional V-thread.

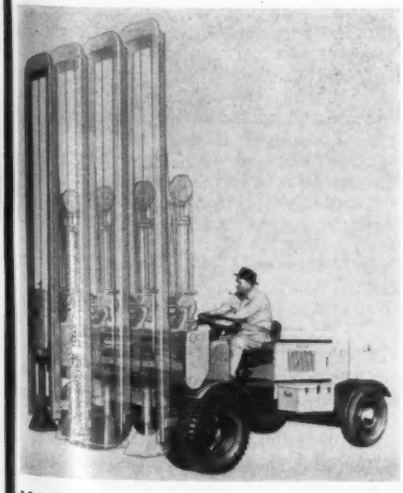
CIRCLE (33) ON THE REPLY CARD

For safety marking of emergency vehicles, barricades, and signal flags, high visibility fluorescent enamel may now be applied quickly with a convenient new finger tip spray dispenser. Ideal for quick stenciling of signs on white cardboard. The hyper-intense fluorescent enamels — yellow, vermilion, orange, and red — reflect up to 4 times as much light energy as conventional colors of the same hue. Appear to increase in brilliance in poor light.

CIRCLE (34) ON THE REPLY CARD

Pipe coating holiday detector developed by Tinker & Rasor provides constant voltage in any climate. Fully portable, new detector requires no generator. Makes use of a unique new electrical field device consisting of a double electrode or plastic coated saddle attached directly to the instrument carrier to create a constant inspection voltage on the line adjustable from 5 to 20,000 kv. Weather or ground conditions will not affect operation as detector performs equally well on wet or dry coatings.

CIRCLE (35) ON THE REPLY CARD



Mobile hydraulic hammer now being manufactured by Arrow Manufacturing Co. gives operator a 7-ft working width when leads are vertical or 8 ft when angled. Designed to work close to abutments, footings, and foundations, hammer can work from side to side across the front of the machine, forward or in reverse, breaking concrete highways, slabs, curb and gutter, and streets.

CIRCLE (36) ON THE REPLY CARD

Get the facts and you'll get Lone Star line pipe

Gathering, distribution and transmission lines.. using Lone Star API line pipe.. give trouble-free service month after month and year after year.

Every length of Lone Star pipe is subjected to the API hydrostatic tests in length of time and degree of pressure. Yes, Lone Star is rigidly quality-controlled from mining of ore to finished pipe. Lone Star fully normalized casing, tubing and line pipe are made strictly to Joe Roughneck's standards.

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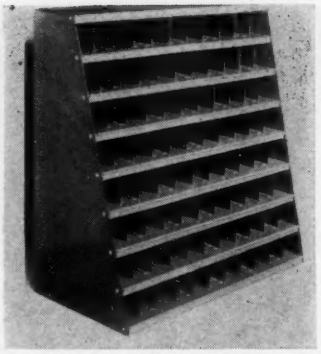
PRODUCT PARADE

"Off-the-shelf" computer programs for public utilities industries will be available from IBM this fall. Specifically for applications of solid-state IBM 7070 data processing system, the program defines 75 to 80 percent of an individual utility's billing and accounting operation, permitting greater speed in designing the proper system while offering flexibility to meet special requirements of each utility. Using the program, a utility will be able to start its 7070 billing and accounting operations months—perhaps a year—earlier. Saves much programming effort by including both general and detailed block diagrams of the programming system, as well as the actual coding in Autocoder.

CIRCLE (37) ON THE REPLY CARD



VARIABLE DEPTH TOOL AND PARTS STORAGE UNIT suitable in gas company service departments for small parts such as controls, burners, etc., is now available from Bay Products Division. Shelves vary in depth from 16½ to 7-in. so each part can be kept at the front, easily visible and reached. Bin dividers are also adjustable horizontally on 1-in. centers and a full width label holder is provided for each shelf. Overall cabinet size is 33⅝-in. wide and 17-in. deep by 34½-in. high so that it can be inserted into standard steel shelving.

CIRCLE (38) ON THE REPLY CARD

NEW EDP system handles full range of utility data processing needs. Royal Precision Corporation's latest product, a fully-transistorized RPC-9000 Electronic Data Processing system can handle rate tables, billing, trend determination, Hardy Cross calculations, and many other utility applications. New model incorporates many advanced computer design features and provides automatic "in line" records-processing, a new concept in electronic data processing. Data is accepted in random order and all affected records are automatically up-dated in a single uninterrupted sequence of operations.

CIRCLE (39) ON THE REPLY CARD

Latest addition to J. I. Case line of wheel tractors and equipment is a gasoline-powered model designed primarily for use as a 2500-lb capacity loader and a 3000-lb capacity backhoe. Can be used with a wide choice of interchangeable equipment including crane boom, dozer, all-purpose blade, and scarifier-scraper. Hydraulic foot-operated swing controls enable operator to swing the backhoe boom a full 180 deg leaving both hands free to maneuver bucket controls while swinging.

CIRCLE (40) ON THE REPLY CARD

Epi-seal epoxy resins manufactured by Bonded Products, Inc., are now available in a compact gas repair kit, can be used on corroded sections of pipe, leaking threads at a fitting or valve, to plug cracks, breaks, and holes in fittings, cast iron, steel pipe or copper tubing. Kit requires no special tools or skills and is compact enough to take little space on trucks, cars, or tool carts. Repairs pipe breaks and holes "gas tight" with as much as a 5 to 1 factor, even on high pressure distribution lines. Now used by more than 50 gas companies.

CIRCLE (41) ON THE REPLY CARD

GENERAL REPAIR MATERIAL. Plastic Mastic, a new epoxy-polyamide chemical compound, is now being marketed through industrial distributors by Williamson Adhesives, Inc. The material, it is claimed, can repair floors, walls, ceilings, driveways, curbs, masonry, bricks, machinery, fixtures, tanks, pipes, plumbing, and can be used for filling leaks, breaks, holes, and cracks. The material is permanently effective with almost every known material such as concrete, metals, wood, ceramics, glass, rubber, cloth, and most plastics. Mixture can be formed to fine edge, and in its cured form, can be sanded, drilled, and machined to a smooth surface.

CIRCLE (42) ON THE REPLY CARD

NEW LANCASTER VALVE COVER

*Gum-resistant ring Specially compounded of friction-free inert carbon-graphite

*Large-Profile Stud offers greater contact area

eliminates practically all troubles from normal sticking or lifting valves . . . Lancaster Valve Covers prevent valve squeaks with a gum-resistant ring compounded of inert, friction-free carbon-graphite. Strong and shock-resistant, this special compound is far less apt to chip or break in transit or during repair or installation.

In use, Lancaster Valve Covers provide the most level and truly concentric seat surface ever achieved.

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keeps pans moving in a straight line . . . Height is adjusted at side carrier bracket for most accurate positioning. Oval slots in new center bracket permits diaphragm to travel in straight line. Porous bronze graphite bearings are used throughout. You can order oval-slot center brackets separately and adapt them to any carrier wire.

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PRODUCT PARADE

CATERPILLAR TRACTOR COMPANY has added a new line of wheel loaders. Three new models — one, the 944, is in production now, and the other two, 922 and 966, will be available later this spring. All three loaders have similar configuration and machine design features. Most readily recognized feature is the locating of all lift arms and hydraulic cylinders ahead of the operator's compartment. Powered by either a gasoline or diesel engine, the Traxcavator 944 is fitted with a 2 cu yd capacity bucket as standard equipment. Both gasoline and diesel engines are rated at 105 net hp. The 922 will be available with either a 4 cylinder, turbocharged diesel engine, or a 6 cylinder gasoline engine. Standard bucket is 1.25 cu yd; maximum bucket lift is 134 in. At 7 ft bucket clearance, there is 38 in. reach. Turning radius of the machine is 19 ft; it has a top speed of 32.2 mph. The third model, No. 966, is powered by a 6 cylinder, turbocharged diesel engine with a 2.75 cu yd capacity bucket as standard equipment. Maximum lift is 154¼-in. and at 7 ft clearance, there is 37.75 in. reach. Turn radius for this machine is 20 ft, 9 in.; top speed is 27.5 mph.

CIRCLE (43) ON THE REPLY CARD

Air-flow meter developed by Highland Engineering Co. is called the first air-flow measuring device with direct "deadbeat" or precise readings. Heretofore air-flow measuring devices have had a bobber inside a glass tube that kept bouncing up and down with every fluctuation in velocity. New flow meter utilizes a dial actuated by a turbine wheel attached to a spring wire. As air flow velocity rotates the turbine wheel, the torque created is opposed by the spring of the wire, thus registering the rate of flow in the circular calibrated dial. Applicable for high pressure commercial air conditioning systems or for by-pass metering of the flow of gas in pipelines. Current model permits direct read-out of all flows from 20 to 200 cu ft per minute at any pressure from 2 to 12.5 psig. However, meter can be made in small or large capacity units and will measure air or liquid flows to nearly any limit at pressures up to 5000 psi.

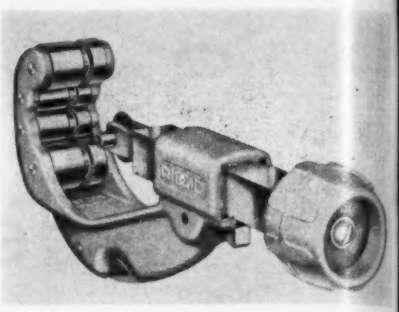
CIRCLE (44) ON THE REPLY CARD

Fisher Governor Company is now marketing an easily readable travel indicator for attachment to the Type 99 high pressure gas reducing regulators. Designed to facilitate field installation, the indicator is an integral part of the spring case, replacing the casting now used. Indicator plate is graduated in percent of valve opening, and the traveling portion of the indicator, colored a brilliant red, is encased in a Pyrex glass tube for permanent protection from dirt and the elements. Indicator stem is screwed to the end of the diaphragm rod with a simple threaded adaptor.

CIRCLE (45) ON THE REPLY CARD

Natural gas cutting torch can cut through 30-in. of metal in a single pass, can handle every manual cutting job encountered in factories, foundries, steel mills, fabricating shops, and scrap yards. Ideal for removing large risers; handles with ease special jobs such as gouging, rivet piercing, and pad and fin washing. Has large gas flow—up to 3000 cu ft per hour of oxygen and 250 cu ft per hour of natural gas. Using interchangeable injectors it is possible to use either low or medium-pressure natural gas.

CIRCLE (46) ON THE REPLY CARD



TWO NEW RIDGID TUBING CUTTERS, featuring fully enclosed feed screws that can't jam with chips or dirt, have been introduced by Ridge Tool Co. Cutters give quick clean cuts of copper, brass, aluminum tubing, and thin-wall conduit. Each carries a spare cutter wheel in handle. Special cutter wheel for the 205 model is available for cutting plastic and aluminum pipe. Model 105 has a ⅛ to 1⅛-in. OD capacity. Model 205 has a ⅛ to 2⅜-in. OD capacity.

CIRCLE (47) ON THE REPLY CARD

Table top small parts bin, designed to hold a maximum number of bulk parts in a minimum space, measures only 33 in. wide by 34 in. high by 9 in. deep, and contains a total of 56 compartments each 4 in. wide by 8¾ in. deep. Vertical partitions between bins are adjustable with snap clips to meet material requirements.

CIRCLE (48) ON THE REPLY CARD

Newly-developed Braden Model CL hydraulic winch separates power and storage functions of winch drums to provide constant load, constant speed, constant torque and constant horsepower. Safety brake is completely automatic, both to wear and load, and requires no adjustment. Cable is pulled in by two power drums while a storage drum gathers the load. Although rated at 12,000 lb capacity, new model winch outperforms conventional 20,000 lb units by 4 to 6 times.

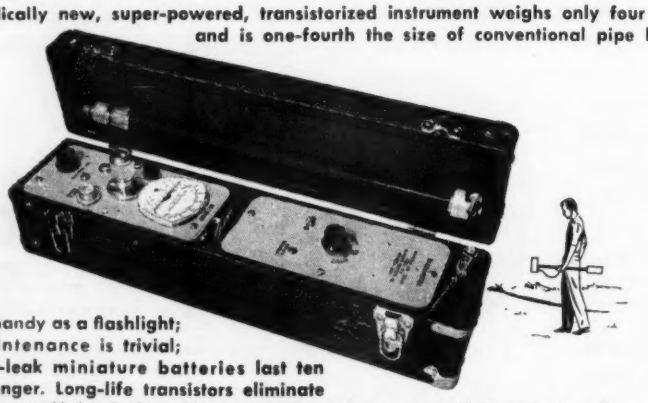
CIRCLE (49) ON THE REPLY CARD

NEW 1960 MODEL M-5 TRACTOR by Minneapolis-Moline is the first in a series of tractors in the 60 to 70 hp class. Gives "instant access" to all controls in the newly-created "comfort control zone" centered on the driver's platform. Unusually large luxurious seat with thick foam rubber cushion is adjustable to operator weight and height. Designed for today's trend to large work unit, tractor develops an estimated 78 brake hp, 65 belt hp, and 59 drawbar hp on gasoline and LP-gas models at a normal governed speed of 1500 rpm. Moline's celebrated "Tel-O-Flo" hydraulic system, with single or double acting cylinders, gives instant control of 3-point hitch, front-mounted, or remote tools; affords selection of most efficient working depth for any soil, and allows proper rate of application or "drop" for both light and heavy implements.

CIRCLE (50) ON THE REPLY CARD

The MINIATURIZED-PRECISION WILKINSON Line Locator Model W-3

This radically new, super-powered, transistorized instrument weighs only four pounds and is one-fourth the size of conventional pipe locators.



It is as handy as a flashlight; the maintenance is trivial; the non-leak miniature batteries last ten times longer. Long-life transistors eliminate replacement. Molded glass fibre cases. Transistor ear set. Telescopic handle. Etches circuitry and unique antenna. Contained in carrying case.

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